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ORGANIZATION FOR NAVY DEPARTMENT ADMINISTRATION.

A STUDY OF PRINCIPLES.

By COMMANDER YATES STIRLING, U. S. Navy.

Motto: "Non Omnia Possumus Omnes."[1]

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[1] We cannot all of us do everything.

In the preparation of this paper, the following books and papers have been read and freely quoted wherever they seem to throw light on the subject under study:

Naval Administration	Sir Vesey Hamilton.
Naval Administration	Rear-Admiral S. B. Luce.
Naval Annuals, 1911, 1912	Lord Brassey.
Duties of the German General Staff	Von Schellendorf.
Ocean Empire	Fiennes.
Military Policy	Upton.
Naval Administration and Warfare	Mahan.
London Times—Organization	Various Articles.
Naval Administrations	Briggs.
Naval Efficiency	Hurd.
The Admiralty of the Atlantic	Hislam.
United States Economy and Efficiency Board's Report.	
Reorganization of British Army	Lord Esher.
Papers on Faults of Department Organization	Admiral Luce. Captain W. S. Sims. Captain W. L. Rodgers.
Various Books and Articles touching the subject	Admiral Darrieus.
The Brain of the Navy	Wilkinson.
The Brain of the Army	Wilkinson.
Military Transport	Furse.
Provisioning Armies in the Field	Furse.
Lines of Communication	Furse.
Mobilization of an Army Corps	Furse.
Gideon Welles' Diary	Wells.
Business Organizations	Professor Person.

INTRODUCTORY.

A navy is created for a definite purpose. The philosophy of war points out that the army and navy are the visible manifestation in the determination of a nation to continue its existence along the natural paths dictated by its reasoned decisions. These decisions may become national policies.

The statesmen of a government conceive the intention of definite action in the event of a definite contingency. This intention for national action becomes a *policy* when it awakens response in the community behind the statesmen. When this policy gains the support of the *whole* nation, it attains the dignity of a national doctrine. The Monroe Doctrine is such a policy. The army and navy are the visible manifestation of the nation's de-

termination to enforce that doctrine, which is, therefore, a warning to all nations that may wish to challenge it.

The statesman at the helm of government employs, in his diplomatic intercourse with other nations, *means* which vary with the situation. These *means* may be termed *instruments*. These instruments are for the purpose of enforcing the *national will*. *War* is the most potent instrument and is used only when all other *means* have failed; it is to the statesman the *ultimate instrument* of his diplomacy.

It, therefore, is the duty of the statesman to foresee and prepare his armed forces against the rise of a nation that may vigorously challenge his nation's doctrines, even to the ultimate—war.

A doctrine challenged cannot exist unless there is sufficient *force* behind it to maintain it.

Policy, therefore, must be everywhere co-ordinated with the nation's *force*.

The nation's *force* is its army and navy. "In peace they are the potential arguments of diplomacy; in war the dynamic power of the State for the realization of its policies."

The effectiveness of the navy depends upon its size, its character and its efficiency for battle. Its size is controlled by the legislature. Its character and efficiency for battle are in the keeping of naval administration. The statesman and naval administration must stand as advisers to the legislature upon the size of the naval force required.

Co-ordination between the statesman and the naval administration is beyond the power of the navy to control, but the conception of a plan of organization for naval administration, one that can give free effect to each of its vital efforts, *is* the task of the naval officer.

DEFINITIONS.

"Organization is the process of arranging or systematizing; specifically the process of combining parts into a co-ordinate whole."—*Century Dictionary.*

"Socially as well as individually, organization is indispensable to growth. Beyond a certain point there cannot be further growth without further organization."—*Herbert Spencer.*

Channing has written: "The body is a healthful and beautiful organization only when the principle of life acts generously through all its parts."

"The man whose moral organization is under due control never acts on mere feeling; but invariably submits it to reflection."—*Spencer.*

The organization of an art or business is purely a mechanical act and success cannot rightly be credited to the perfection of such arrangements alone, there must in addition be present a "principle of life" acting generously through all its parts. This mysterious something which must be fused with the completed structure makes the task more elusive. Organization is then seen to be no longer constructed solely upon the foundation of fundamental principles, mere clay to the hand of the potter; it must, at last, be struck by a magic wand and the principle of life created within before it can become an effective instrument to a definite end.

The "principle of life" may be said to be *full co-ordination under a plan.* The structure of organization provides channels through which must pass all effort. Each effort must add full measure to the accomplishment of the plan, else *full* co-ordination has not been achieved.

An organization may be perfect in structure, providing channels for each necessary effort, and yet, if there is no plan, no aim, upon which effort can focus, co-ordination cannot exist.

On the other hand, if an organization is imperfect—if some of the necessary channels of effort are clogged or too shallow to pass the full stream; if some channels have not been cut—then even the existence of a plan will not give that full co-ordination of effort so vital to success.

Upon this assumption a study of the material required in building the structure of naval organization appears to be logically the initial task. Organization is a science. In every science there exist immutable laws. These laws or principles must serve as unerring guides in the building of the structure.

To seek out and recognize these principles will be the first step of this paper.

Through the channels of naval administration, naval business is conducted. Organization for naval business is, therefore, organization for naval administration.

Administration is, then, but another name for business, and a study of its principles cannot fail to help in the task of constructing an organization for naval administration.

FORMS OF ORGANIZATION FOR BUSINESS.

Economics and accounting are sciences well understood. Administration and management, especially for public service, are fields of investigation as yet only partially explored.

There are two forms of management known to business men: (1) The hierarchical form and (2) the functional form.

By the hierarchical form the general manager has *entire* charge of the business. Immediately under the general manager is a second manager. To the latter all business is delegated except a certain portion reserved by the former. Under the second manager a third manager may be created who controls all business except a portion reserved to the second, and so on.

Under this form of organization there exist no co-ordinate subsidiary managers. Control where delegated is on a personal basis. Delegation of authority does not follow any natural division of the functions of the business. Any of the managers may be thus responsible for a vast variety of functions, some wholly unrelated.

The organization on the functional basis, the one followed in business of this day, involves a division of business along lines in which activities are closely related. *Group managers* are co-ordinate and equal, and further responsible only to the *general manager.*

It is the functional form of organization which is described on the following page.

*A STUDY OF BUSINESS ORGANIZATION.

The simplest form of organization is one for business purposes. The aim of business is to produce revenue. Reduced to simple terms it will be seen to consist of three branches under a manager.

(1) The *internal* branch, which spends money for labor and material.

(2) The *external* branch, which obtains money by delivery of the work of the internal branch.

(3) The *inspection* branch, which keeps the manager informed as to the efficiency of the internal and external branches.

As the object of business is revenue, it is self-evident that the internal branch will conduct its work in accordance with the plans

*Condensed and re-written from a paper on Administration and Business by Captain W. L. Rodgers.

of the external branch, as formulated by the latter in order to satisfy the customers.

Information that comes to the manager as to the success of the business must be trustworthy, and to be so it should come from those independent of the branches engaged in executing the work, and for which they are responsible. This is a *fundamental principle of inspection.* An elementary diagram of business organization is shown in Diagram 1.

The process of business is to convert the money in its treasury into labor and material and finally to reconvert these back into money. The balance sheet measures the profit obtained and the degree of success of the business.

In business, as we ascend the hierarchy, the individuals are in responsible charge of more than they are able personally to superintend. They therefore divide the work and apportion it out among their subordinates. Each subhead has an inspection staff to keep him informed of progress. Inspections should not be made by those dealing with the article to be inspected, whose interests lie naturally in suppressing the knowledge of faults or defects.

In a broad sense the external branch finds business and suits the customers; the internal branch works under the direction of the manager upon information supplied to him by the external branch. In this way the external branch is virtually inspector of the work of the internal branch; not as to the methods of work, which are quite beyond its province, but as to the final product and its suitability for the market.

The work of the external branch itself is inspected and influenced (in its work) by the public (the customer), which makes its demands felt in the sale of the article or articles for which the external branch is responsible.

COMPARISON OF GOVERNMENT BUSINESS WITH PRIVATE BUSINESS.

The first point discovered in such comparison is that government business is *not* carried on for financial profit. An organization for naval administration must have its *internal* or spending branch and its *external* or revenue branch, yet the income of naval business cannot be shown upon a balance sheet in money.

The success of naval administration can be judged only by the known readiness of the naval forces for war. Those armed

Naval Chief.
The Secretary of the Navy.
A civilian.
Civil Branch.
Eight co-equal Bureaus, providing for the needs of the Navy.
Inspection Branch.
Inspection and Survey.
for Ships and Shore Stations.
The Fleet.
Navy Yards.
(3.)
Manager.
External Branch
Internal Branch.
Inspection Branch.
(1.)
Naval Chief.
Chief Adviser
Command Branch.
Preparation for War.
Civil Branch.
Manufacturing.
Administration.
Inspection Branch.
To be composed of Military Officers inspecting final output only.
(2.)

forces are the *fleet,* for the support of which, both in peace and in war, naval administration owes its creation.

This difference makes it a difficult task to diagnose the faults in a naval organization for administration—so difficult in fact that all solutions to the difficulty move upon quick-sandy soil. The best we can hope to accomplish is to base our organization upon fundamental laws, and trust that in providing an organization which in its architecture does not violate any great law of nature or otherwise, the personnel of the naval establishment, through its patriotism and loyalty, will bring that *full co-ordination under a plan*—the "principle of life"—without which the organization can be at best only a lifeless and cumbersome structure, incapable of providing the fleet and preparing it to fight a winning battle.

The object for which a navy exists is, in the ultimate, war. And war, to be waged successfully, must be planned and carried on by men trained for such special and scientific work; therefore, it may be written as a fundamental law that in any naval or military organization for administration, superiority or precedence must be conferred upon that side which plans and directs the war (external branch) in preference to the side that provides the means necessary to support the war (internal branch).

This should be considered one of the most important laws of naval organization, and one which will be violated at the country's peril.

To follow the analogy between private business organization and naval administrative organization, Diagram 2 has been made. Here the command branch is shown to be given preference over the other advisers, but otherwise on an equality of footing, which we shall see later cannot achieve success under a manager unfamiliar with either branch of the business.

The *mission* of Navy Department administrative organization is the preparation of an instrument for the purpose of war.

The command or military branch of the naval organization, upon whose shoulders falls the conduct of war, should be responsible for the preparation of the navy for war, and as a necessary consequence must direct all other branches.

The administration or civil branch should be responsible for the matériel supplied to the command branch with which it will work in peace to prepare for war and in war to win the decision in battle.

The inspection branch, *directed* by the class to which belongs the conduct of war, should inspect the work of both the command branch and the civil branch.

In Diagram 2, if the naval chief is a naval officer or a military Emperor, then the preference to the command branch has already been given; the naval chief representing in his person the superiority of command over administration. If on the other hand the naval chief is a civilian, such superiority of those who will fight the ships over those whose duty is to provide the means within the money allowance given by Congress must be clearly drawn and enforced.

In a military organization the requirement that the class of officers to which belongs the conduct of war shall inspect the quality and quantity of the output of the civil branch, its suitability to the conditions of war, and further be assured that the moneys given by the legislature are expended in order to give full effect to the preparedness of the fleet for war, flows directly from the *axiom* that "the knowledge of suitability of the output for war is a *military responsibility* and must not be reposed in the civil branch of the organization."

It might be here stated, although the fact appears self-evident, in drawing our analogy between ordinary business and governmental administration, that ordinary business is in constant practice, and from its daily experience new standards of work are established. As war is infrequent, and as the fleet must always be held ready to exert its maximum service instantly, it becomes the duty of the military branch of the naval organization to make research into history for principles of the art of war and keep itself constantly informed upon the practices of foreign armies and navies and its own military resources. From these studies is derived the knowledge required to inspect the output of the civil branch in quality and quantity and to be assured that this output is suitable for war.

DISTINCTION BETWEEN COMMAND AND ADMINISTRATION.

Farrow's Military Dictionary thus makes the distinction between command and administration:

> Administration and command are distinct. Administration is controlled by the head of an executive department of the government under the orders of the President, by means of legally appointed administrative agents with

or without rank; while command, or the military discipline, control and direction of military service of officers and soldiers (sailors), can be legally exercised only by the military hierarchy at the head of which is the constitutional Commander-in-Chief of the Army, Navy and Militia, followed by the commanders of the army and navy and other military grades created by Congress.

By a decision of the Supreme Court of the United States, the Secretary of War has been declared the commander of the army, in his person representing the military command authority, as it were, of the President. Under the analogy, therefore, our Secretary must be at the head of both the command branch and the administration branch, and responsible for the preparedness of the fleet for war in peace, and the military direction of the fleet in war.

Administration defined from Farrow's Dictionary, changed to define naval administration:

Administration is controlled by the heads of the executive departments of the government, under the orders of the President of the United States, by means of legally appointed administrative agents. . . . . Administration of government consists in establishing the ways and means of public receipts and expenditures; in watching over such employments, in the collection, care and distribution of material and moneys; and in rendering and auditing accounts of such employment.

THE ORGANIZATION FOR NAVAL ADMINISTRATION EXISTING BY LAW.

The naval organization, in so far as it is created by Acts of Congress, is shown in Diagram 3.

At the head of the organization is the Secretary of the Navy, a civilian, member of the President's Cabinet to advise him in all matters pertaining to the naval arm of national defense, and by decision of courts, commander of the naval forces. Under the Secretary, for the administration of the navy are eight co-equal bureaus, whose authority within the jurisdiction of each is that of the secretary himself. Farrow's Military Dictionary says:

These branches (bureaus) constitute the *supply military* service of a navy, the operation of which should be so regulated that the Secretary of the Navy will be always informed of the condition of each and will be able to exercise, subordinate to law, a complete financial control over each.

By law, the secretary apportions the duties to the bureaus. These duties are administrative. The chiefs of bureaus are

"legally appointed administrative agents in the Department of the Navy," and are financially responsible for the disposition of the money appropriated their bureaus by Congress.

This organization for administration of the navy thus gives effect *only* to the *labors* of what has been termed the *civil* branch. Its duties may be said to consist of those necessary to provide for the wants of the fleet and for all the foreseen demands of a state of war, including labor and the supplies of naval bases. Such duties embrace subsistence of men; coal, oil, ammunition, and supplies in general; warships of all types required, naval transports, and auxiliaries of all kinds needed with the fleet or for the care and supply of the fleet; supply of officers and men, and transportation of men and supplies; administrative duties in dockyards and bases at home and abroad; ordnance, torpedo and mine construction; estimating, accountability, payments, recruiting; and in general the receipt and proper application of money.

Six of the bureaus—Ordnance, Construction and Repair, Steam Engineering, Yards and Docks, Supplies and Accounts, Equipment (abolished by last Congress)—deal entirely with matériel. Their duties are to convert the monies allotted them into labor and material and to reconvert these back into revenue to the country. Revenue to the country *should be readiness for war.*

The inanimate fleet and its bases are the concrete productions of the labors of the matériel bureaus. The Bureau of Navigation provides the officers and men to inhabit them, but that branch which must wield the whole as a weapon of war is by law nonexistent within the organization for administration.

The Bureau of Navigation is also an administrative bureau of the Navy Department. The administration and direction of the personnel are its principal functions. But Congress having failed to provide a *branch* for command duties, there grew up before the Meyer reorganization the custom of entrusting the military duties of the Department of the Navy to this bureau, "in addition to its other duties." Yet, by law it has not been given precedence over the other bureaus. Such precedence has been, however, acquired by reason of its directive duties. The seven matériel bureaus (the civil branch) that supply the needs of the military branch did not always feel in duty bound to conform to the standards set them by the Bureau of Navigation. And

further, the Bureau of Navigation, deeply involved in routine matters of administration, did not fully appreciate that if it was to efficiently perform the duties of the command branch of the organization for administration a plan must be evolved to which the civil branches must be co-ordinated, if preparedness for war was to be achieved.

If the Secretaries of the Navy had been military men, they must have long since understood the grave dangers of this faulty organization, and being responsible to the country for the preparedness of the naval force, would have striven to correct these inconsistencies.

If the officers of the navy to whom belong the conduct of war had all thoroughly realized the illogical form of the organization and applied themselves to an exhaustive study of their profession, the art of war, such a hopeless condition could not have so long endured. There was one naval officer, however, who as early as 1888 began to write, in the *Service Institute,* appeals to the navy for reform in the naval organization. It was Admiral Stephen B. Luce, founder and first president of the Naval War College. He said on this particular matter:

> By far the most striking feature of our naval government is its deficiency in the military branch. . . . . The civilian Secretary of the Navy is left entirely alone to wrestle with that division of his labors as best he may. Numerous technical questions come up for his consideration which cannot properly be referred to any one of the eight bureaus—questions which belong to the Secretary's office alone, and which should be decided in his office. He turns to one bureau chief and gets one opinion; to another and gets another opinion. Consulted independently, each regards the question from his own standpoint, mostly, and quite naturally, from the standpoint of his own bureau, which is not always that of the other bureaus or of the general service. Moreover these questions are often foreign to the duties of the bureau chiefs, and may refer to subjects to which they have given little attention. This is far from encouraging to a Secretary new to office, and he will look in vain for that portion of the organization of his department to which he can properly refer the great mass of technical details which now absorbs so much of his time, to the exclusion of the civil affairs peculiar to his office. In short a Secretary of the Navy is, from the very moment of his entering upon the duties of his office, placed in an utterly false position.

It is thus seen that the Department of the Navy is by law organized only for the civil duties and without the necessary military direction. That branch which should prepare the fleet for war

and plan for the prosecution of war has been left to be formed on the outbreak of hostilities. Our history furnishes proof that for both the army and the navy this has ever been the grave fault in the past.

EFFORTS FOR REFORM.

A fundamental law of organization is that there must exist "authority down and corresponding responsibility up." The eight bureaus each have equal authority down, but the responsibility for the efficiency of the fleet for war is individual only with the Secretary himself, and since he is a civilian, to hold him to such a responsibility is seen to be a weak convention.

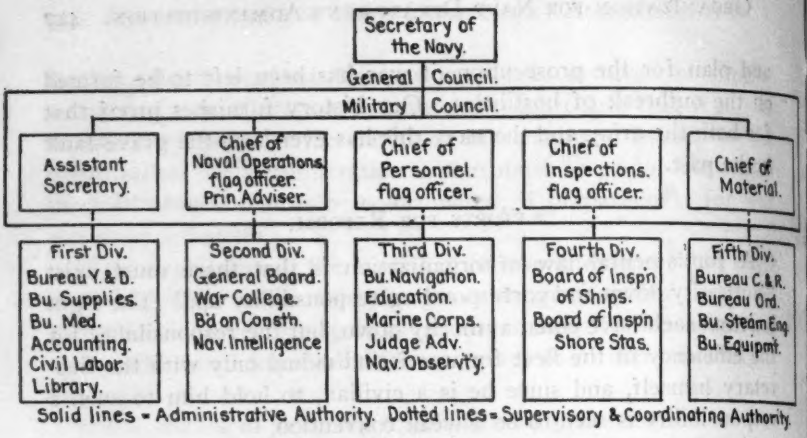
The Secretary is by law a civilian, and it is well that it is so. It is, therefore, logical and necessary to give to the civilian Secretary a military branch in the organization in which he can repose the most absolute confidence, to advise him and be responsible for the advice in the matter of standards to which the civil branch must conform to produce efficiency for war.

Admiral Luce in 1888 laid down what he considered the principles of naval organization. This was twenty-five years ago. Diagram 4, shows diagrammatically the form of an organization in Admiral Luce's mind, as constructed from his declaration of principles.

In 1909 a board composed of some of our ablest men, of which Ex-Secretary Moody was the presiding officer, handed to the President certain principles which they believed should form the foundation for reorganization of the Department of the Navy, together with their report. A sketch of a proposed organization was also submitted and is produced here in Diagram 5.

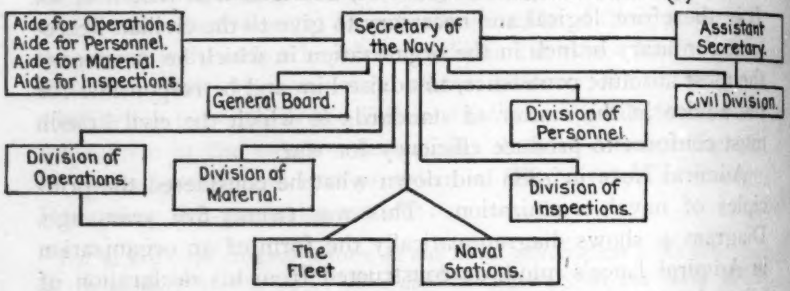
Diagram 6 shows diagrammatically the reorganization of the Department of the Navy as put into effect by Secretary Meyer. This Secretary, soon after he came to the office, was aware that Congress had so far failed to provide him the means of properly coordinating the interdependent bureaus. Means were at hand only to furnish the weapons and maintain them. Being a civilian, and therefore unversed in military affairs, he was powerless under the old order to intelligently control the many conflicting and semi-independent interests. Mr. Meyer appreciated at once that there must be a military branch of the naval organization, and that without it there could be no unity of action to give the organi-

MOODY BOARD PLAN OF NAVAL ORGANIZATION. (5.)

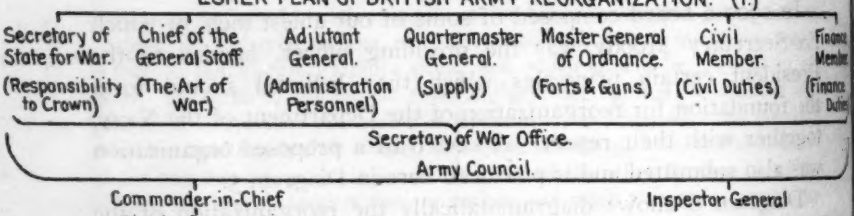


Solid lines = Administrative Authority. Dotted lines = Supervisory & Coordinating Authority.

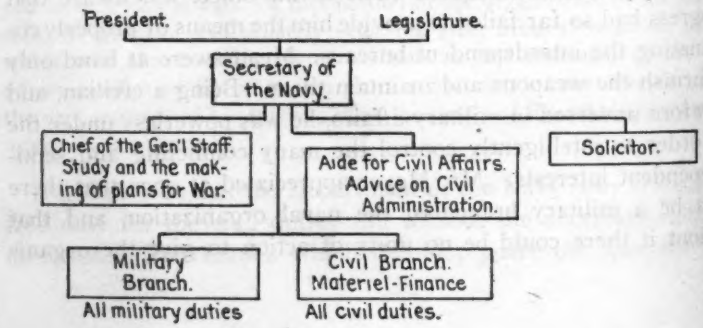
MEYER PLAN OF NAVAL ORGANIZATION. (6.)



ESHER PLAN OF BRITISH ARMY REORGANIZATION. (7.)


Secretary of State for War. (Responsibility to Crown)
Chief of the General Staff. (The Art of War)
Adjutant General. (Administration Personnel)
Quartermaster General. (Supply)
Master General of Ordnance. (Forts & Guns)
Civil Member. (Civil Duties)
Finance Member (Finance Duties)
Secretary of War Office.
Army Council.
Commander-in-Chief
District Commanders.
Inspector General

LUCE PLAN OF NAVAL ORGANIZATION. (4.)



zation efficient and economical progress in accomplishing its mission—preparation of the fleet for war. His was the responsibility not alone for the efficient administration, but also for the accomplishment of the mission of the organization. Such a grave responsibility without that military assistance which by all the laws of common sense was his right, caused him to act at once to better these unmilitary conditions. The reorganization shown in Diagram 6 was the outcome of the deliberations of a board known as the Swift Board.

The Meyer plan places the command branch in partial control of the military direction of the navy; but as it has not the force of law, under a new Secretary the organization may lapse back to the basis of the statute, where the civil branch is given full power to work without consulting the command branch, which must bring the revenue to the country—Victory in battle.

Captain W. L. Rodgers, in a paper on Naval Administration, states this principle:

> The requirements of the fleet in commission, as formulated by the office controlling it, are demands which it is the duty of the spending bureaus to meet.

England's war in South Africa made army reform imperative. For this purpose a committee was appointed in 1904, headed by Lord Esher. This committee studied exhaustively the broad questions of military administration. It pointed out dispassionately, but none the less forcefully, the faults in the army system of administration. It shed new light upon the immutable laws which, although possibly recognized, were being consistently violated. Further, it constructed an organization for the command and administration of the British Army that has dragged it from the mire of ignorant conservatism and placed it upon firm soil. (Diagram 7.)

The Esher report shows such a clear grasp of principles that it must form the groundwork of any study for administrative reform.

In 1909, the Moody Board submitted its report.

If we are to further pursue the elusive laws of organization for administration, nothing can profit us more than a comparison of these two reports.

For this purpose the method of the *deadly parallel* has been invoked. What each has to say upon identical questions is here set down.

MOODY BOARD, UNITED STATES.

1. The office of the Secretary of the Navy being executive in character, nothing should be admitted into an organization of the Department which would qualify his authority or diminish his ultimate responsibility. He must under our form of government be a civilian. He is the representative of the President, the constitutional Commander-in-Chief, under whose direction his authority is exercised.

ESHER COMMITTEE, GREAT BRITAIN.

We consider that as a first step in the reconstruction of the War Office, the position of the Secretary of State for War should be placed on precisely the same footing as that of the First Lord of the Admiralty, and that all submissions to the Crown in regard to military questions should be made by him alone. The complete responsibility to Parliament and the country, of the Secretary of State, for the discipline as well as for the administration of the army, must now be accepted as definitely established.

Both committees appear to agree on this principle of the responsibility of the civil head of the Executive Department to the State.

2. The duties in charge of the Secretary divide under two principal heads, closely related, but generally distinct: military and civil. The civil duties embrace the provision or preparation of all material of war. This is the function of the present bureaus. The military duties concern the use of that material, whether in war or in such exercises as conduce to fitness for operations of war. For the direction of these military duties, no subordinate provision corresponding to the bureaus on the civil side exists in the present organization established by statute.

The War office, as was pointed out by the Hartington Commission, has no *thinking department*, and the branches concerned with preparations for a campaign, and with the collection of necessary information, are weak, and not sufficiently in touch with the Secretary of State for War. At the same time, the duties and the responsibilities of the military heads are ill-defined, and their relations to each other and to the Secretary of State are not such as effective administration demands. No distinction between *policy* and *routine* work exists, and the military heads, absorbed in work with which they ought to have nothing to do, have no time for the proper consideration of questions of real importance, or for exercising foresight and initiative.

Both the Moody Board and the Esher Committee appreciated the need of a body to plan for war.

3. The discharge of both these classes of duty involves a multitude of activities, quite beyond the immediate personal knowledge and supervision of a single man. This

The next step is the constitution of a board, or as we prefer to call it an Army Council, following the general principles which obtain at the Admiralty. The Council should

necessitates a subdivision of the duties, by which means the supervision of the Secretary is exerted through the medium of responsible subordinates. In this subdivision the *principle* of *undivided responsibility within the appointed field of subordinate supervision* should obtain as it does in the superior office of the Secretary. *Independent authority* with *undivided responsibility*, as now established in our bureau system, though seeming correct in principle, suffers historically from intrinsic inability to co-operate where a number of such independent units are present. The Marshals of Napoleon in Spain, in the absence of the Emperor, offer a familiar illustration. The bureau system constituted by law contains no remedy for this inherent defect.

4. Due to lack of technical knowledge of the Secretary, there should be an advisory body, composed of several persons equipped not with advice merely, but *with reasons*. In order to avoid the interruption of continuity attending each new administration, entailing the recurrent temporary unfamiliarity of each new Secretary, the body should be composed of several persons; but while this provision would insure the continuity which inheres in a corporate body, continuity of knowledge and progress, the principle of undivided responsibility would dictate that *one* only of them should be responsible for the advice given to the common superior, the Secretary.

consist of seven members, four military and three civil, with the Permanent Under-Secretary as Secretary. We attach great importance to a scientific grouping of the duties of the members of the Council. Attempts to combine the administrative and executive functions of the army have led to confusion, to reduplication of work, to dual control and to divided responsibility.

His Majesty's Government having approved of the establishment of an Army Council, we consider it advisable to explain in general terms their duties and responsibilities. One of the principal objects is to prevent the crystallization in the War Office of narrow habits of thought or of obsolete methods. This can be achieved by a constant infusion of new blood into the administrative branches of the office. Four years should be the maximum period during which an officer can hold the position of a military member of the Council. He should then return to active employment on the staff or in command. Members of the Council will act as colleagues of the Secretary of State at the Council table and as superintendents of the several branches into which the business of the War Office is divided. The responsibility of the Secretary of State will be shared by the members of the Council. The executive orders will be issued in the name of the Council as a whole.

5. As regards the composition of the advisory body, the principles to be regarded are two:

(A) The end dictates the means.

(B) The responsibility must be individual, in advice as well as in executive action.

(A) The end is efficiency in war. The agents in war are the military naval officers. Their profession qualifies them best to pronounce upon the character of the preparations for war, of every kind.

What the Secretary needs, specifically and above all, is a clear understanding and firm grasp of leading military considerations. Possessed of these he may without great difficulty weigh the recommendations of his technical assistants, decide for himself and depend upon them for technical execution of that which he approves.

However constituted in detail, the advisory body should be taken entirely from the class to which belongs the conduct of war, and upon them will fall in war the responsibility for the use of the instruments and for the results of the measures which they recommend.

(B) The officer selected to command the fleet in war to be head of advisory board.

An essential principle in the constitution of such an advisory body is that the majority of the members should be on the active list and should go afloat at no infrequent intervals; and specifically the head of the body should take command of the fleet when concentrated for maneuvers, etc., to sustain his familiarty with administrative routine and other practical matters.

6. No scheme of naval organization can possibly be effective which does not recognize that the requirement of war is the true standard of efficiency in an administ-

The main duties of members as superintendents of branches will be: (a) To take any action entailed by Council's decisions. (b) To give decisions not requiring Council's authority. (c) To bring before Council important questions which may arise in connection with the work of their branches and may require decision by superior authority.

Members of the Council will be responsible for the efficient working of their branches, and in order that responsibility may not be divorced from power, they will have full control over the personnel acting under their orders.

It is essential to prevent the members of the Council from becoming immersed in detailed administration. They cannot be experts in the entire work of their branches, and should superintend rather than directly administer. The main administrative work of the military branches will be carried out by directors acting under members of Council. Broadly speaking, questions of policy will be decided by the Council, while administration will devolve upon the directors. The object is to secure such a grouping of duties as can be administered by directors or heads of sections possessing expert knowledge. Communication between the Secretary of State and the military members of Council, and between the latter, will be mainly personal.

For the first time in the long annals of War Office reform its intricate problems have, we believe, been approached from the point of view of war rather than from that

trative military system. That success in war and victory in battle can be assured only by that constant preparedness and that superior fighting efficiency which logically result from placing the control and responsibility in time of peace upon the same individuals and the same agencies that must control in time of war.

There should be no check or change of method in expanding from a state of peace to a state of war. This is simply a business proposition to give the people proper investment for their money. of peace. The scheme we have laid before you is based upon the consideration that the preparation for war is the primary object of a war office, and that no military organization can be sound in time of peace unless it is applicable to the necessities of war.

In appointing the members of the Army Council no consideration except that of special fitness for the duties involved should arise. Military rank to remain unchanged.

Independent inspection is the corollary of effective *decentralization.* The constitution of an Army Council as the supreme administering body of the military forces, and the measures of decentralization which are a necessary consequence, will render effective inspection absolutely imperative. The *Army Council* is to administer and not *command* the army. Executive command being vested in generals outside the War Office, who will be responsible for the training and efficiency of all troops within their districts, an independent Inspection Department must be provided for the information and protection of the Council. An Inspector-General of the Forces should be appointed for a period of five years, who should command and direct the various inspectors.

The main object sought is to provide the Secretary of State and Council with eyes and ears other than those of the administrative heads of the War Office, who cannot have time or opportunity for inspection. The duties of the Inspector-General should be those of review and of report upon the practical results of the policy of the Army Council within the financial limits laid down by the Cabinet. His sole functions would be to report upon actual facts without expressing opinions upon policy.

It should be here noted that the Esher Committee was directed that the Admiralty organization *must* be considered the correct form upon which the army reorganization should be based. Without these instructions, it is likely that the Esher and Moody Boards would have agreed upon the principle of the one responsible adviser.

ANALYSIS OF THE TWO REPORTS.

The Esher Committee recommended for the army, a Council, which was to be one and indivisible. The Secretary of State for War was to be a member of this Council. The higher administration of the army was to be the duty of this Council. Its direction was stated to be administrative only and it *was not to command the army.* As the eyes and ears of the Council, an Inspector-General of the Forces was recommended. (Diagram 7.)

The Moody Board recommended that an advisory body be established, composed of "the class to which belongs the conduct of war," and that "*one only of them* should be *responsible* for the advice given to the common superior, the Secretary." The members of this advisory body were for the purpose of giving advice with reasons to the Secretary upon technical questions.

Under the Esher plan the army is *administered* by a council and the work of the Inspector-General will measure the success of the *administration.*

The army is divided into corps, each under the military command of a lieutenant-general. The corps are based upon *administrative* districts under a major-general.

The major-general is in the military sense the subordinate of the lieutenant-general, but the latter is thus freed from cares of administration and has only to train his corps for its ultimate service.

Under the Moody plan the administration of the navy would be directed by the Secretary, with the military assistance of the *one principal adviser.* The other advisers on technical matters must come to the principal adviser with their advice, with reasons, and not to the civilian Secretary. If the navy was found to be unprepared for its mission, war, the *one principal adviser* must shoulder the full military responsibility.

Under the Esher plan, the responsibility being with a Council, unless the public are alive to the urgent need of a navy prepared for war, *administration* might cast the deciding vote and the command branch, upon whom must rest the responsibility in war, would find itself thus out-voted by the spending branches represented in Council.

In England, where a national menace exists and is understood by the "man on the street," the Army Chief of the General Staff, corresponding to the Navy First Sea Lord of the Admiralty, works with but scant interference for the preparation of the service for war. "It would be difficult for an under lord of the Admiralty to hold his seat if he found himself opposed to the war policy of the First Sea Lord."

The Moody Board contained the following men known nation-wide: W. H. Moody, Paul Morton, Stephen B. Luce, A. T. Mahan, and A. G. Dayton, a member for many years of Congress and of the Naval Committee. The board's report was made in 1909, five years after the Esher report in England.

The letter accompanying the Moody report is here reproduced to show how clearly this board understood the faults in our Navy Departmental organization as constituted by statute.

> The commission on naval reorganization convened . . . . has the honor to submit the following broad embodiment of the principles of naval reorganization. . . . .
>
> It is conceded that the present organization of the Navy Department . . . . has performed the business of the Navy Department adequately. its shortcomings have not been due to any deficiency in skill or want of business capacity in administration, but rather because the organization has lacked the principle of responsible military advice to the Secretary.
>
> The object and ultimate end of the Navy Department are to build, arm, equip and man the fleet in order to prepare it for war. It is conceivable that in a highly developed industrial community like our own the business of the Navy Department might under its Secretary be restricted to its military duties only, the supplies of every nature, including the vessels themselves and their entire war outfit, being obtained by purchase, as has been illustrated in certain foreign countries. The predominant character and importance of efficient military counsel will thus be appreciated.
>
> We, therefore, beg to submit an outlined plan of reorganization in illustration of the "principles" of the report of the commission dated February 20, 1909, in which an endeavor has been made to supply the deficiencies to which attention has been directed. *We however, desire to emphasize the expression that this is merely an illustration of the principles and not a digested plan.*[1]

[1] The italics are the author's.

The Bureau system in its entirety has been retained, but with additional personnel. Its powers, but not its duties, have not been curtailed and it is believed that these last have been usefully co-ordinated.

The necessity for the increase in the superior personnel of the Navy Department will be obvious. It is illustrated in the growth of every industrial development. The additional cost will be nothing when compared to the savings in administration.

In so far as concerns the fundamental principles laid down in both the Moody and Esher reports no exceptions are possible. That there exist principles of administration deduced by Lord Esher which have been given no place in the Moody report will be taken up later.

These two reports bring the study of organization to a point behind which it would be of small value to explore.

Lord Esher states:

New measures demand new men and we therefore attach special importance to the immediate appointment of military members who have not hitherto been closely connected with existing methods and are therefore not likely to be embarrassed by the traditions of a system which is to be radically changed.

Regarding this in the substance rather than in the form, a question for decision arises as to the advisability of abolishing the bureaus. This has been advocated by writers on the subject of naval administrative reorganization. It may, however, be stated emphatically that as long as the very large money appropriations are divided among the bureaus, the real power will remain where are the purse strings. If Congress will permit the Secretary of the Navy, through his auditor, to allocate the money appropriated where it will give the greatest efficiency, and further take away the *executive* power of the bureaus, then the retention of the bureaus will add to efficiency, rather than otherwise, for we shall then be able to continue interdependent organizations fully manned. All that is now required is co-ordination under a plan, and for this the initiative must come from the military branch of the organization, upon whom rests the responsibility of the preparation of the fleet for war.

FUNDAMENTAL PRINCIPLES OF ORGANIZATION.

It will now be advisable to pause awhile and dissect what has been written in the foregoing pages. Principles have risen to view, but doubtless in the mind of the reader have not arranged

themselves in orderly sequence to be firmly grasped. An endeavor to accomplish this will, therefore, be attempted.

First, before further progress in this study can be made, the object or mission of naval organization for administration must be accepted. It is couched in the phraseology of the Moody Board's report.

Mission.—The mission of naval organization for administration is to provide a means for success in war and victory in battle. No scheme can possibly be effective which does not recognize that the requirement of war is the true standard of efficiency in an administrative military system. Success in war and victory in battle can be assured only by that constant preparedness and that superior fighting efficiency which logically result from placing the control and responsibility in time of peace upon the same individuals and the same agencies that must control it in time of war. There can be no check or change of method in expanding from a state of peace to one of war.

Forethought.—There must be a thinking section, and the branches concerned with preparation of plans for a campaign and with collection of necessary military information must be sufficiently in touch with the responsible head of the organization.

Precedence.—The military branches in the organization for administration must be given precedence over the civil branches that supply their needs. In the concrete case of the navy this means that the requirements of the fleet in commission as formulated by the office controlling it, are demands which it is the duty of the offices of the spending bureaus to meet.

Responsibility.—The responsibility of the *head of the organization* to Congress and the country must be clear and absolute. Within the organization there must be provided adequate authority down with corresponding responsibility up.

Administration.—The administration and command functions should not be combined. Administrative chiefs should not command the navy, but should administer to the needs of the fleet in accordance with the reasoned plan.

Inspection.—A report upon facts by one not concerned with administrative work must carry more weight than the conflicting demands and statements of those engaged in the art of persuading financial authorities to increase the total of the estimates.

Grouping.—Kindred subjects should be grouped together under a single management, so that divisional heads of offices have charge of related matters in an ascending series of increasing complexity, with an unbroken chain of responsibility existing from the lowest to the highest official. No activity shown necessary for war must be omitted.

Centralization.—The centralization of a vast number of incongruous functions in a head of an organization will result in the neglect of work of primary importance. (This is now strikingly exemplified in our department organization. The necessary peace activities are performed; the potential activities for war are left undone.)

Selection For Administration.—Men should be chosen for their fitness and no question of rank should be allowed to arise. Men of exceptional ability can obtain fair results from a bad system, but under a good system of organization personal shortcomings produce the minimum of disadvantage, and can be more readily detected. It is of the essence of a bad system of organization that mediocrity or worse is effectively shielded.

Decentralization.—Decentralization should be sought in an organization in order that the central office may not be burdened with more duties that it can properly discharge, and on the other hand that *officers may be trained to exercise initiative and to accept responsibility.*

And now the essence of good organization must be added:

Co-ordination.—Co-ordination among the subheads of an organization must have its roots in a *doctrine* and a common knowledge of the other duties and line of progress. There must be no divided authority. Authority in every case must carry with it the responsibility for the act. The greatest strength of an organization can be exerted only through perfect *co-ordination.* In order that there may be co-ordination there must be a known mission or aim toward which all efforts can be directed. Theoretically, the mission may be expressed as "the preparation of the fleet for war," but this mere phrase is insufficient to arouse all to a proper performance of duty to attain the end.

If we are to have military efficiency in our naval organization, we must go farther than the mere construction of the form which principles tell us the organization should take. We must be

assured that within the organization there will flow the *principle of life.* This task can be accomplished only through the full awakening of the American people, as represented by the President and Congress, to the realization that questions of national defense are of more importance than any other issues, and that these questions must be given the fullest consideration by men specially trained and possessing the knowledge necessary to answer them in accordance with the underlying principles involved, and not by opinions formed hastily and without sufficient thought or study.

Once a *Council for National Defense* is formed to consider the broad questions of the nation's military (including naval) policy, from that will flow naturally a naval building program, a program based upon the mature consideration of *all* conditions

A definite building program for the navy will give to every individual in the naval service a definite "arrival point" toward which he can bend every effort. A definite building program will call forth the administrative plans to place the fleet upon an efficient peace and war footing. It will furnish the full data upon which logistic and strategical plans for war can be based. A further study of this *national need* will be found later in this paper.

A STUDY OF FOREIGN NAVAL ORGANIZATIONS FOR ADMINISTRATION.*

Organization for naval administration must naturally be made to conform to the form of government of a nation, and, therefore, in a study of foreign organizations this requirement must be always kept in view. Our desire is to discover how we may adopt measures that have been elsewhere successful, provided other conditions over which there can be no control can be satisfied. Our one aim is to produce an organization for administration of the navy which will efficiently support the fleet in the preparation for war and in the conduct of war, if such a contingency should arise.

The diagrams are self explanatory. They show how exhaustively other nations have considered and treated such detail of administration. Activities are seen recorded there for which our administrative organization has not provided a channel.

* No originality in the description of organization of foreign Navy Departments is claimed. In all cases these descriptions have been verified.

ADMIRALTY ORGANIZATION FOR COMMAND

First Lord.

1. General direction of all business.
2. Promotions and removals-officers.
3. Appointments of all flag officers.
4. Civil appointments and promotions.
5. Naval cadetships and nominations to asst clerkships.

First Sea Lord.

Organization for War. Distribution of the fleet.

1. Preparation for War; all questions of naval policy and maritime warfare - to advise.

2. Fighting and sea-going efficiency of the fleet, its organization and mobilization, including complements of ships as affecting total numbers.
System of gunnery and torpedo exercises of the fleet, tactical employment of air craft, and all military questions connected with the foregoing.
Distribution and movements of all ships in commission and in reserve

3. Superintendence of the War Staff and the Hydrographic Dept.

Second Sea Lord.

Personnel.

1. Recruiting and manning and training of fleet. Details of complements of ships and establishments.
Barracks, training and educational establishments with their complements. All mobilization regulations for the personnel.

2. Service and appointments of officers of all branches

3. Royal marines.

4. Coast guard and Reserve forces.

5. Hospitals.

6. Discipline.

7. Signals.

Third Sea Lord.

Materiel.

1. Design of materiel for the fleet, including ships and their machinery, armour, naval ordnance and gun mountings. Aeroplanes and airships and docking facilities.
Alterations and additions to ships which affect design or fighting efficiency.
Preparation of estimates of cost of all new construction falling due under programmes.
Superintendence of the departments of the Director of Naval Construction, Engineer in Chief, Director of Naval Ordnance, Director of Naval Equipment, Director of Air Department, and Superintendent of Compasses.

2. Design questions affecting vessels proposed to be purchased for the fleet or to be employed in auxiliary service.

3. Inventions relating to ships, machinery, etc.

4. Salvage of vessels so far as technical and professional considerations are involved

Fourth Sea Lord.

Stores and Transport.

1. Transport service including hired auxiliary vessels other than armed merchant cruisers. Passages.

2. Superintendence of naval store, fleet coaling and victualling services.
Ordnance and medical stores, etc, and all questions relating thereto.

3. Full and half pay Allowances and compensations and all extra payments. Debts of officers and men. Pensions, character, conduct and badge questions. Naval savings banks.

4. Medals. Uniform regulations.

5. Naval detension quarters and Bodmin Naval Prison. Deserters. Rewards for apprehension. Removals of R. (Ran)

6. General salvage money. Questions and money demands for salvage of naval stores.

7. Collisions

AND ADMINISTRATION OF THE NAVY (8)

Lord.

6 Chaplain of the fleet. Appointment of and entry of chaplains and instructors.
Royal and Admiralty yachts, appointment of Officers.

Civil Lord.	Second Civil Lord.	Parliamentary Sec'y	Permanent Secretary.
Works, Buildings. Greenwich hospital.	Contracts and DockYard business.	Finance.	Admiralty business.
1. Works and buildings, including purchase of lands. Coast-guard buildings, sites and leases.	1. Contracts for materiel for the fleet (including ships and their machinery, armour, naval ordnance and gun mountings, aeroplanes and airships.) Works, yard machinery and stores of all descriptions. Contract arrangements in connection with the disposal, salvage or loan of vessels or stores. Superintendence of the contract and purchase department. Important tenders will also be marked to the Third Sea Lord.	1. Finance, estimates and expenditures generally, and all proposals for new and unusual expenditures.	1. General office organization.
2. Staff of civil establishments including classification, appointment, promotion, pay, allowances and pensions. DockYard police.	2. General organization of dock yards, including provision of labor and plant and all business questions in connection with the building and repair of ships and their machinery, whether in dockyards or in private yards.	2. Accounts, cash, store and dockyard expense.	2. Discipline of the clerical staff of the various Admiralty departments.
3. Greenwich hospital business, including appointments. (exceptions)		3. Purchase and sale of ships and of stores generally.	3. Admiralty procedure.
4. Charitable fund, compassionate allowances, subscriptions etc., and allowances for religious purposes.		4. Payment of hire of ships as armed merchant cruisers, troopships, colliers, freight ships, etc.	4. Recommendations for appointments and promotions in the Admiralty office.
5. Marine and dockyard schools.		5. Questions involving reference to the Treasury financially, except the less important works questions dealt with finally by Civil Lord.	5. Correspondence.
6. Special questions affecting retirement and pay of naval and marine officers and men when discretionary power is specifically provided for by order in Council.		6. Exchequer and audit department, questions with.	6. Communication with foreign naval attaches.
		7. General labor questions including annual petitions.	7. Communication with ministers of religion other than English Church.
			Routine papers.

In the discussion of each organization no attempt, therefore, will be made to describe the detail material of the structure. The organization will be looked into from a broad view-point. The object will be to examine its structure; to see if it is founded upon sound principles, or otherwise, and then to decide why it has succeeded or failed.

THE BRITISH ADMIRALTY BOARD. (DIAGRAM 8.)

The First Sea Lord represents the military branch of the organization. The second, third, and fourth, the two civil lords, and the Parliamentary Secretary are of the civil supply branch. They supply men and material to the fleet. They execute the business of repairs. They maintain localities for refit. They pay the bills. They audit the accounts, etc.

There is no inspection branch. The board makes its own inspections or else delegates this duty to officers of high rank and standing.

The Admiralty Board is a council presided over by the civil First Lord. Executive departments are assigned to the supervision and co-ordination of members of the Council or Board of Admiralty. Thus the lords of the Admiralty are free from administrative labors and, therefore, able to consider broad questions of policy which our chiefs of bureaus fail to find time to consider.

The Board of Admiralty now exercises the power once vested in the Lord High Admiral of England. In the reign of Henry VIII, the Navy Board was established in addition to the Admiralty. The purpose of this board was to undertake the civil supply administration, while the executive duties of the Lord High Admiral as Commander-in-Chief remained with the Admiralty office.

The *Navy Board* in course of years became so powerful through its political associations as to get out of harmony with the Admiralty, and in consequence there was much waste, inefficiency and fraud on the part of the Navy Board.

In 1830, it was seen that such an organization was impossible. The Navy Board was controlled by politicians who refused to be corrected by the Admiralty. The abolishment of the Navy Board and the distribution of its duties among the members of the Board of Admiralty became a necessity.

Sir Vesey Hamilton says in this connection: "By the disposition thus taken the Board of Admiralty and the subsidiary departments acquired the united and flexible character they have

today, that character which they possessed before the civil departments had attained their magnitude and semi-independence, and were yet closely in touch with the Admiralty, holding the means—when they exercised them—of controlling and supervising the business for which they were responsible."

The *internal* branch of the organization had drifted away from the control, direction and inspection of the *external* branch, upon whom was the responsibility of waging successful war. In putting the internal branch under the Admiralty Board, upon whom this responsibility rested, the organization again became logical and effective.

As with England, whose naval efficiency rests upon the British Parliament, our ultimate efficiency rests upon Congress. The British Navy is strong and efficient because the public of England desires a strong, efficient navy and this desire is reflected in the acts of Parliament. There is a national menace present which has forced the public to turn to the preparedness of its army and navy. There exists a definite policy and an *arrival point* for the naval organization.

This menace has forced both those in the government and those in the naval service to speak freely. In this way Parliament has been furnished with the *facts* in regard to naval administration.

When public opinion within the service is stifled, the outside public is deprived of the information which is needed if faults in administration are to be corrected.

The First Sea Lord is the principal naval adviser of the First Lord, who is a cabinet officer, and a member of parliament by virtue of his office. Sir Vesey Hamilton, himself once a first Sea Lord, points out that the other lords would find it difficult to hold office if their views on important matters before the board should diverge seriously from those of the First Sea Lord.

The First Sea Lord is held by the British public to be responsible for the preparation of the fleet for war. He is the man toward whom all eyes turn. His responsibility is the efficiency of the fleet and the actual employment of the fleet. His opinion exercises great weight as to character and sufficiency of the material as well as of the personnel. Under the First Sea Lord is the General Staff of the navy. In his person the First Sea Lord combines all the duties of the command branch of the naval organization for administration, and in fact, if not by law, is the *one principal naval adviser to the First Lord.*

The British public service is one of intellectual attainments much above the average. Policy in relation to war and the navy's place in diplomacy are subjects well and correctly understood by all who call themselves diplomats, legislators or politicians. Besides, there are hosts of educated men in England who are constantly holding before the eyes of the people, through the medium of the public prints, the necessity for a navy and the necessity also for its preparedness for war with an enemy—not a visionary enemy, a long way across the ocean, but one within arm's length; an enemy armed and ready, imbued with the spirit of war, of offensive war. All this has aroused, throughout the British Empire, a well-understood reason as to the necessity of a large and efficient navy. With such a menace there are administrative plans for war. Naval administration is founded upon the plans and is efficient and sufficient to carry out the plans.

England has its building plan, and the navy is thus given the "arrival point" toward which all administrative effort, as well as fleet effort, is directed.

It should be noted, further, that the naval appropriations are in the form of a budget, and the money is apportioned in lump sums by votes. These total sums can be further allocated by the Admiralty Board as in its judgment it sees fit, provided sanction can be received from the Treasury Department.

The British Cabinet all hold seats in Parliament and are held responsible for the budget of government. If a budget fails to receive Parliamentary sanction, the Ministry falls, and a new party automatically comes into power. Thus there is a decided difference between the British form of government and our own, but this difference is more in form than in fact and at least not so radically different from our own as to prohibit us from following her lead along the lines of the general principles of naval administrative organization.

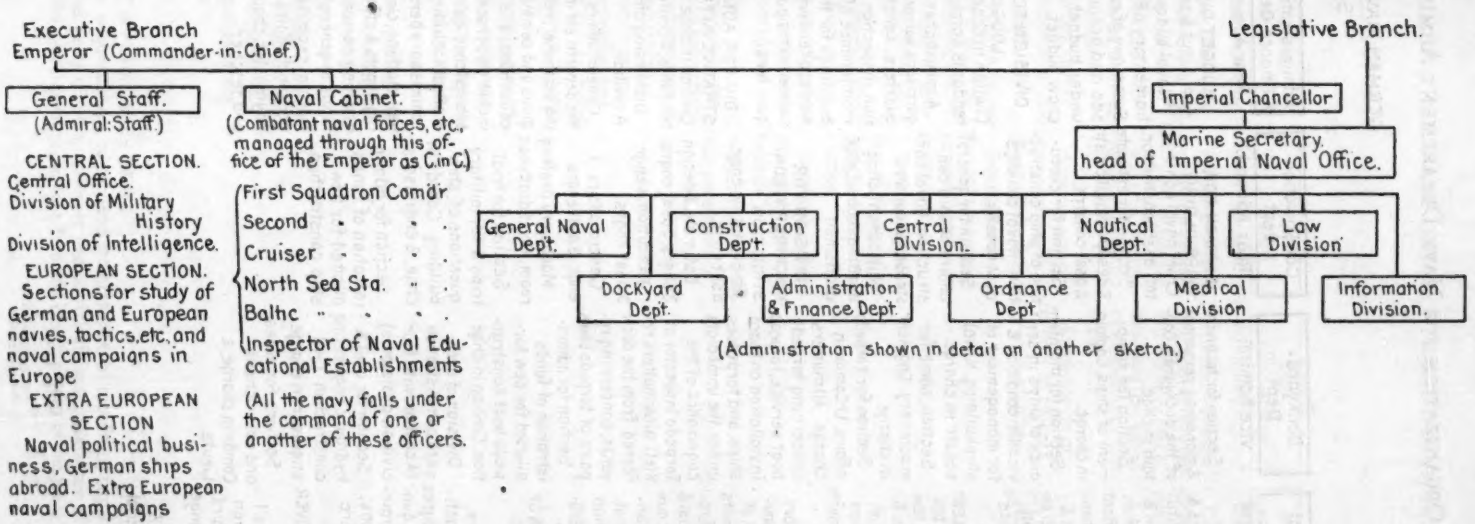
GERMAN NAVAL ORGANIZATION. (DIAGRAMS 9 AND 10.)

The Emperor is the life-giving force behind the German organization. The army and navy are his to command and administer as he sees fit, obtaining from the legislature the money required to carry out his aims.

The management of the navy is controlled through three great administrative offices, all directly subordinate to the Emperor, as

GERMAN NAVY (9.)

Summary of Organizaton of Navy Department.


Executive Branch
Emperor (Commander-in-Chief.)
Legislative Branch.
General Staff.
(Admiral Staff.)
CENTRAL SECTION.
Central Office.
Division of Military History
Division of Intelligence.
EUROPEAN SECTION.
Sections for study of German and European navies, tactics, etc. and naval campaigns in Europe
EXTRA EUROPEAN SECTION
Naval political business, German ships abroad. Extra European naval campaigns
Naval Cabinet.
(Combatant naval forces, etc., managed through this office of the Emperor as C. in C.)
First Squadron Comdr
Second " " "
Cruiser " " "
North Sea Sta. " "
Baltic " " "
Inspector of Naval Educational Establishments
(All the navy falls under the command of one or another of these officers.
Imperial Chancellor
Marine Secretary.
head of Imperial Naval Office.
General Naval Dep't.
Construction Dep't.
Central Division.
Nautical Dept.
Law Division
DocKyard Dept.
Administration & Finance Dept.
Ordnance Dept
Medical Division
Information Division.
(Administration shown in detail on another sKetch.)

GERMAN NAVAL ORGANIZATION

Secretary of State for

General Naval Dept.	DocKyard Dept	Construction Dept	Administration & Finance Dep't.	Central Division
Vice Admiral	Vice Admiral	Rear Admiral.	Rear Admiral	Captain.
MILITARY DIV. Captain, 5 officers & 1 engineer constituting organization & naval administration afloat; service afloat in general; education & training; uniform & clothing; personnel establishment & supply; Intelligence service on German Coast.	Section for technical & managing personnel of the dockyard's. Captain in chge.	DIVISION FOR SHIPBUILDING. Chief naval constructor, asst constructor.	BUDGET DIV. Capt. Lieut & civilian. Naval budget; Parliamentary affairs. Summary of expenses and accounts under budget. Kiautschow budget.	General management.
LAW & BENEVOLENT INSTITUTIONS DIV. 3 civilian military lawyers. Court martials & other military law affairs. Administration of funds & endowments in aid.	Section for equipment of ships. Captain in charge.	Section for estimate & design. Naval constr. 2 asst constrs.	DIVISION FOR LODGINGS. Civilian in chge, 2 intendants, 2 architects.	Organization of the navy.
MOBILIZATION DIV. 2 Lt. comdrs. Organization & personnel of reserve; arrangements for mobilization of reserve naval material & merchant service auxiliaries; commissioning of ships; general affairs of mobilization.	Section for maintenance of ships in servicable condition & for management of shipbuilding. Naval constr in charge	Section for execution of ship construction. Naval constr, 3 asst constrs.	Administration of garrisons, barracks & quarters; construction, inspection and maintenance of buildings for the same; attendive personnel; extra pay for quarters.	Organization, administration and distribution of business of the Navy office.
MILITARY CONSIDERATIONS IN SHIP CONSTRUCTION & OF TRAINING IN GUNNERY & ARMS. 1 comdr, 3 lt comdrs, 1 engr. Nautical, tachical & military features of design of ships; gunnery & small arm training; firing regulations; target practice & fire control.	Section, same for machinery. Engineer in charge	Section for general affairs of ship construction. Naval constr., 3 asst constrs.	DIV FOR ADMINISTRATIVE AFFAIRS. Civilian in chge. 2 intendants, 2 civilians.	Promulgation of general orders, regulations, instructions and communications.
DIVISION FOR OVER SEA TRANSPORT. 1 captain; 2 lt comdrs; 1 major; army; 1 civilian (intendant) All affairs, organization & arrangements for the sea transport of naval & army forces & material	Section for torpedo affairs. Lt Comdr in charge. All matters concerning torpedo boat service, torpedo installation on board ships, and torpedoes under the immediate cognizance of the Torpedo Inspector at Kiel; also matters referred from the dockyards, concerning repairs of torpedo boats	Ship constructing drafting room. Chief draftsman	Disbursing office A civilian.	Issue of publications
	Section for administration of funds allotted for new torpedo boat construction. Civilian in chge	DIVISION FOR MACHINERY CONSTRUCTION. Chief marine engr., asst engr.	General affairs of the department including personnel; religious and common educational affairs including personnel; subsistence ashore & afloat including commissary personnel; clothing, clothing depots & offices and their personnel; funds in general, incidental expenses, personal affairs of paymaster, chaplain and teacher	Printing.
	Division of dockyard administration (A civilian with four civilian assistants)	Estimate & design. 3 engrs, 3 asst engrs.		Personal affairs of officers and civil officials where duties are wholly or partly under the navy office.
	Section for civil & hydraulic engineering construction Civil engineer in charge.	Execution, 1 engr. 3 asst engrs.		Decisions of weight or affecting two or more independent authorities.
	Sections for mines and obstructions Comdr in charge, 2 Lieuts.	General affairs. 1 engr. 3 asst engrs.		General coordination of the work of the navy office
		Machinery drafting room. Chief draftsman.		Receipt & distribution of all communications for the navy office
		Section for trial trips & for military questions of ship building. Comdr in chge, 3 engr asstS.		Daily oversight of days business.
		Section for administration of funds allotted for new ship construction.		Communication with authorities outside navy. (attaches etc.)
				Affairs reserved by the Secretary for his own consideration.
				Funds for support (aid) of officers, warrant officers and enlisted men

FOR ADMINISTRATION. (10)
the Imperial Navol Office.

Ordnance Dept.	Nautical Dept.	Medical Division	Law Division.	Information Division.
Vice Admiral	Rear Admiral	Chief Surgeon	Admiralty Lawyer	Lieut Comdr.
DIV OF ORDNANCE CONSTRUCTION. Capt 1 engr & 4 assts 3 Lt Comdrs Design, manufacture, purchase, inspection & tests of armor, guns & other material for ships & coast forts. DIV FOR THE INSTALLATION, CARE & SERVICE OF ORDNANCE MATERIAL AFLOAT. Captain 3 lt comdrs, 2 assts. Care and management of ordnance material afloat; firing & service regulations; target practice and reports of firing. Section for coast fortifications & ordnance depots. 1 lieut comdr. 1 asst. General care and management of ordnance and ordnance stores at naval ports and in naval storehouses & magazines, including personnel except officers. Section for ordnance administration in general. Civilian in chge	Affairs of general and international navigation; control of channels and river mouths as to navigability, Lt. comdr. Nautical survey and chart construction. Captain Collection & dissemination of nautical information, preparation & issue of sailing directions. Lt. comdr. Astronomical books and affairs; text books on navigation; observatories with their personnel. Civilian. Lighthouses, vessels and navigation aids; supervision of coast districts of navigation inspection, pilotage and coast guards, including personnel. Lieut. comdr Navigation instruments, supervision of navigation departments of dockyards. Lt. com'dr Construction and preservation of navigation marks. Civil engr. Administration of civil nautical school ship, fisheries, chartering of steamers. Captain.	Personnel of naval medical corps and hospital employees. Hospital administration & construction. Sanitary equipment of ships and shore establishments. General organization and supervision of naval sanitary matters Professional matters of medicine, surgery and pharmaceutics. Sanitary statistics, study and investigation Education of medical personnel.	Opinions and law affairs generally relative to navy office business (exclusive of disciplinary matters) Examination of proofs of officers private income.	Collection of information from publications. Editing of 'Marine Rundschau' & 'Nauticus'. Intercourse with press; publication of information.

GENERAL DUTIES OF IMPERIAL NAVY OFFICE
General administration; organization, supply and maintenance of material, supply and education of officers and petty officers; estimate and control of funds; execution of the Fleet Law; prescribing the establishment, composition and development of the Naval force.

Commander-in-Chief, and giving effect to his will. They are: The Admiralty Staff, The Imperial Naval Cabinet and The Imperial Naval Office.

The Admiralty Staff directs naval policy in peace, and prepares plans for war and controls the strategic and tactical employment of the fleet.

Through the Imperial Naval Cabinet the Emperor conveys his orders to the various commanders-in-chief, promotes and appoints officers as occasion requires, and maintains the navy in a state of warlike efficiency.

The Cabinet and the Admiralty are the organs of the Emperor for the employment of the fleet, and take their orders directly from him and are answerable to him only.

The Imperial Naval Office, which handles the appropriations and provides the navy, is on a different footing; for in the first place it is a Ministry of State, subordinate directly to the Emperor only in matters of naval organization, but in administrative matters to his Chancellor, who himself is responsible both to the Emperor and the legislature. As the Naval Office draws its appropriations from the legislature, its organization is such as to place it in close relation with the legislature. The State Secretary and certain of his assistants are members of one house, with the right of addressing the other. Thus the *legislature* is able to keep itself informed as to the *administration* of the navy.

The Imperial Naval Office is an administrative establishment merely supplying men and material.

The *technical* work of the navy as a *military* force is controlled by the Emperor through his Naval Cabinet, whereby he turns the men and material into an efficient combatant force, and through his Admiralty Staff, which uses and directs the navy in accordance with the national policy.

The Emperor's Naval Cabinet directs the navy through the flag-officers who are in chief command of the organized fleets and naval bases at home. All the organized combatant strength of the navy is under the control of one or another of these flag-officers, who themselves are responsible for the training and discipline and efficiency of the forces under them.

The two naval stations, North Sea and Baltic, are naval commands entirely distinct from the naval dockyards at the same place (Diagram 11.)

Vessels out of commission are under the Imperial Naval Office; nevertheless they are subject to inspection by the station chiefs, who report to the Emperor as to the condition of such ships.

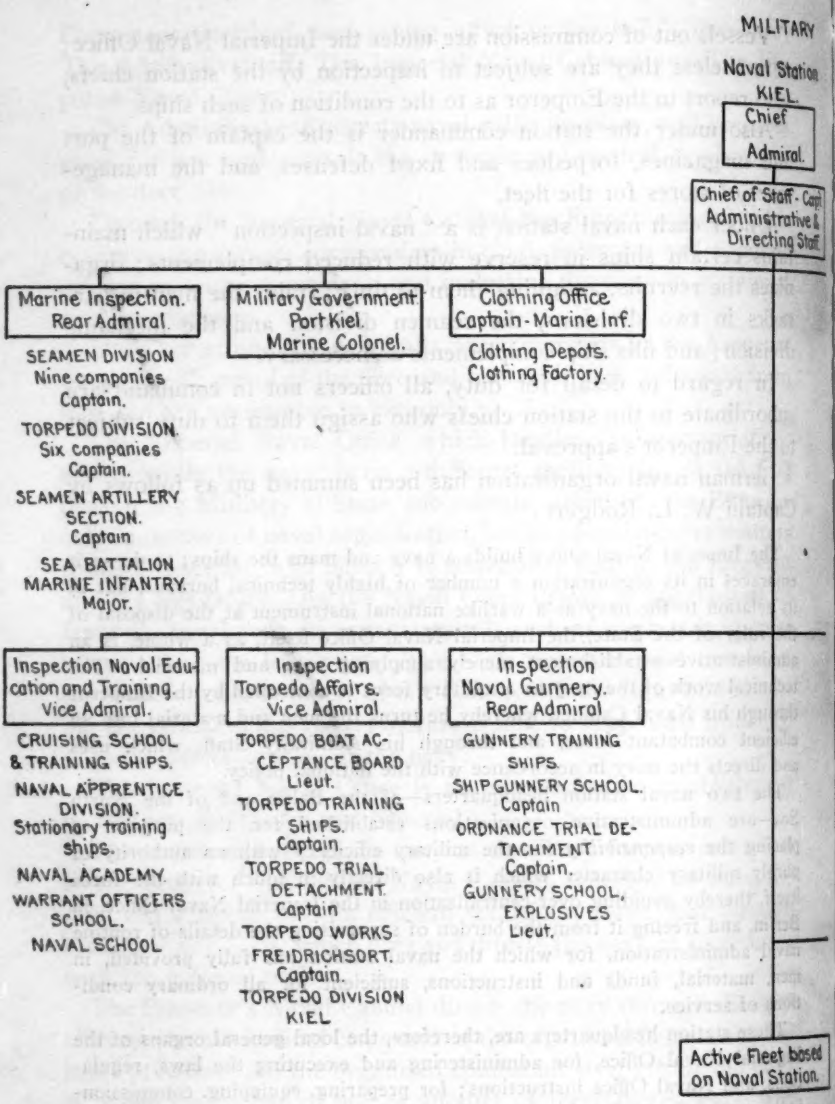
Also under the station commander is the captain of the port and magazines, torpedoes and fixed defenses, and the management of stores for the fleet.

Under each naval station is a "naval inspection" which maintains certain ships in reserve with reduced complements; organizes the recruits, assigning them to duty; trains the men in barracks in two divisions, the seamen division and the mechanic division; and fills ship complements as necessary.

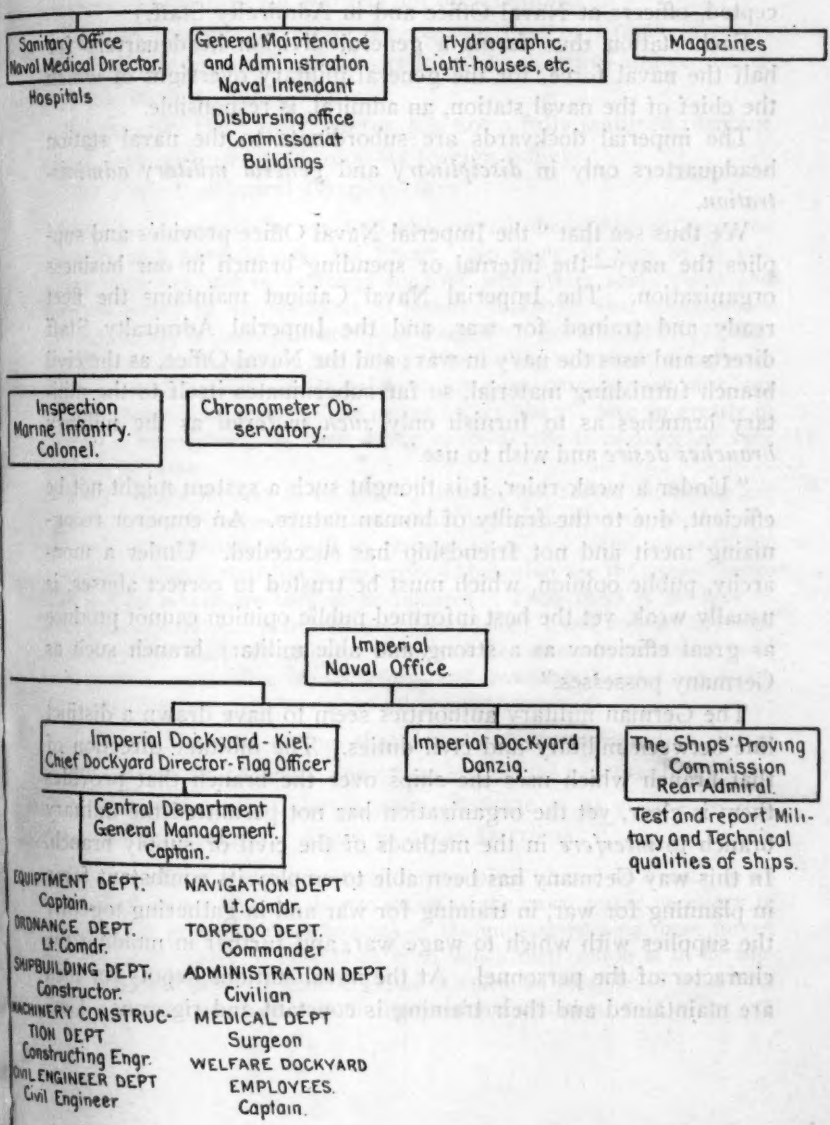
In regard to detail for duty, all officers not in command are subordinate to the station chiefs who assign them to duty subject to the Emperor's approval.

German naval organization has been summed up as follows by Captain W. L. Rodgers:

> The Imperial Naval Office builds a navy and mans the ships; to do so it embraces in its organization a number of highly technical bureaus, but in its relation to the navy as a warlike national instrument at the disposal of the ruler of the State, the Imperial Naval Office itself, as a whole, is an administrative establishment merely supplying men and material. The technical work of the navy as a military force is controlled by the Emperor through his Naval Cabinet, whereby he turns the men and material into an efficient combatant force, and through his Admiralty Staff, which uses and directs the navy in accordance with the national policy.
>
> The two naval station headquarters—of the Baltic and of the North Sea—are administrative organizations established for the purpose of placing the *responsibility* for the military efficiency with an authority of purely military character which is also directly in touch with the force itself, thereby avoiding over-centralization in the Imperial Naval Office, in Berlin, and freeing it from the burden of supervising the details of routine naval administration, for which the naval station has fully provided, in men, material, funds and instructions, sufficient for all ordinary conditions of service.
>
> These station headquarters are, therefore, the local general organs of the Imperial Naval Office, for administering and executing the laws, regulations, and Naval Office instructions; for preparing, equipping, commissioning, manning and officering the active naval force, and subsequently maintaining it, with regular and necessary supplies of men and material; for providing and maintaining in readiness men and material for the reserve naval force; for carrying out all the prescribed preparations for mobilization, and for the execution of all the measures of actual mobilization when declared; for the general military control and supervision over the several subordinate naval organizations on shore; for inspecting reserve ships and


MILITARY
Naval Station KIEL.
Chief Admiral.
Chief of Staff - Capt. Administrative & Directing Staff.
Marine Inspection. Rear Admiral.
SEAMEN DIVISION Nine companies Captain.
TORPEDO DIVISION. Six companies Captain.
SEAMEN ARTILLERY SECTION. Captain
SEA BATTALION MARINE INFANTRY. Major.
Military Government Port Kiel. Marine Colonel.
Clothing Office Captain - Marine Inf.
Clothing Depots. Clothing Factory.
Inspection Naval Education and Training. Vice Admiral.
CRUISING SCHOOL & TRAINING SHIPS.
NAVAL APPRENTICE DIVISION. Stationary training ships.
NAVAL ACADEMY.
WARRANT OFFICERS SCHOOL.
NAVAL SCHOOL
Inspection Torpedo Affairs. Vice Admiral.
TORPEDO BOAT ACCEPTANCE BOARD Lieut.
TORPEDO TRAINING SHIPS. Captain.
TORPEDO TRIAL DETACHMENT Captain
TORPEDO WORKS FREIDRICHSORT. Captain.
TORPEDO DIVISION KIEL
Inspection Naval Gunnery. Rear Admiral
GUNNERY TRAINING SHIPS.
SHIP GUNNERY SCHOOL. Captain
ORDNANCE TRIAL DETACHMENT Captain.
GUNNERY SCHOOL, EXPLOSIVES Lieut.
Active Fleet based on Naval Station.

ORGANIZATION. (11)



other material; and for the general command over all the coast fortifications and shore and fixed defenses of the coast and harbors, so far as they are in the hands of the navy.

The responsibility of the station chiefs is for the efficient utilization of the means placed at their disposal by the Imperial Naval Office; but they are answerable for military efficiency directly and solely to the Emperor.

All officers, men, and ships of the German Navy are assigned to one or the other naval station—Baltic or North Sea. (Excepted, officers at Naval Office and in Admiralty Staff.)

Each station thus forms a general division headquarters for half the naval force, for the general military oversight of which the chief of the naval station, an admiral, is responsible.

The imperial dockyards are subordinate to the naval station headquarters only in *disciplinary* and *general military administration.*

We thus see that "the Imperial Naval Office provides and supplies the navy—the internal or spending branch in our business organization. The Imperial Naval Cabinet maintains the fleet ready and trained for war, and the Imperial Admiralty Staff directs and uses the navy in war; and the Naval Office, as the civil branch furnishing material, so far subordinates itself to the military branches as to furnish only *such material* as the military *branches desire* and wish to use."

"Under a weak ruler, it is thought such a system might not be efficient, due to the frailty of human nature. An emperor recognizing merit and not friendship has succeeded. Under a monarchy, public opinion, which must be trusted to correct abuses, is usually weak, yet the best informed public opinion cannot produce as great efficiency as a strong and able military branch such as Germany possesses."

The German military authorities seem to have drawn a distinct line between military and civil duties. The military direction of that branch which uses the ships over the branch that provides them is clear, yet the organization has not permitted the military branch to *interfere* in the methods of the civil or supply branch. In this way Germany has been able to employ its combatant force in planning for war, in training for war and in gathering together the supplies with which to wage war, and further in molding the character of the personnel. At the naval stations depots for men are maintained and their training is constant and rigorous. Ger-

many accepts the dictum that the moral is to the material as three or five to one, and is striving to mold the character of the combatant force to *win battles*.

FRENCH NAVAL ORGANIZATION. (DIAGRAM 12.)

The French organization, although apparently constructed upon fundamental laws, has not proved successful inasmuch as the efficiency of the fleet for war has not been realized.

Captain Rodgers gives as the reason, that in France there is absent the force outside of the organization desiring and requiring it to be efficient.

France, like the United States, has not a fully matured plan for naval development based upon its foreign policy.

The French Admiral Darrieus says:

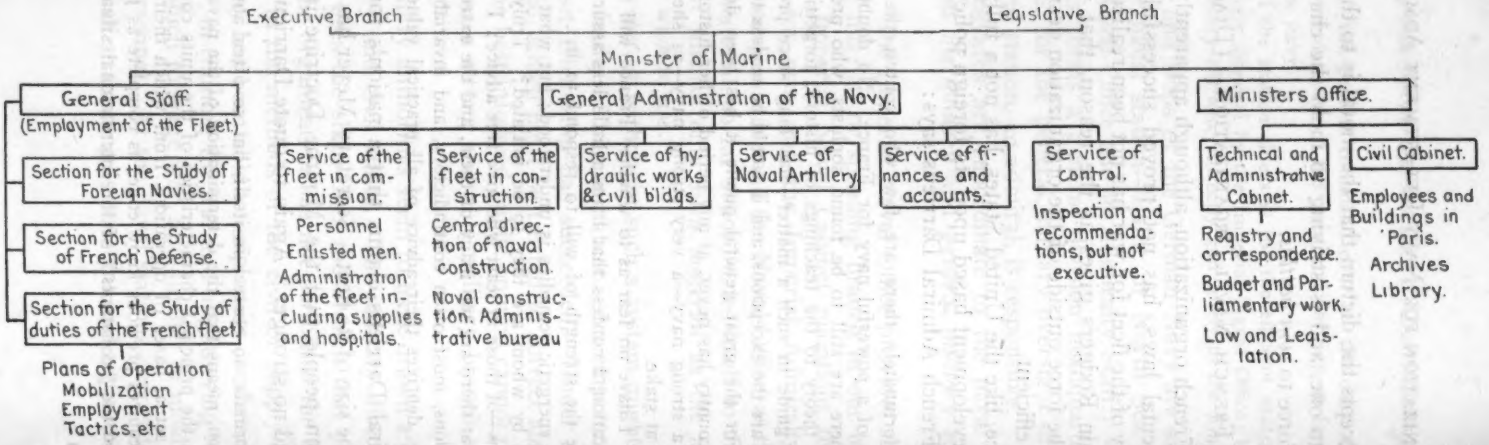
> Very fortunately there are few who contest the utility or even the necessity of a powerful navy for France. No doubt, in spite of all evidence, there are still to be found sophists, who prefer some vague and fantastic theory to the teachings of history, forgetting that experience—the only guide in such a matter—has long since pronounced its verdict. But they are the exceptions, and it would be useless to attempt to convince them. For the great general public it has been demonstrated that our beloved country has never, at any period of her history, been so greatly in need of a strong navy—a very strong navy—as she is to-day; her very safety is at stake.
>
> But, if I have no fear as to whether France will realize ultimately her naval vocation, I confess that I am a little less assured as to whether she will have the strength of will to respond to it. . . . . The necessity for adopting energetic remedies is understood; but what are the proper remedies and by whom are they to be initiated? Truly there is no lack of physicians—of those at least who give free advice; I will even go so far as to say that there are too many of them, and the extreme diversity of their prescriptions, most often contradictory, and invariably based upon faulty diagnosis, deprives their advice of all practical value.

Admiral Darrieus claims that a nation's foreign policy determines the size of its fleet. Secretary Meyer has repeatedly told the American people that the Monroe Doctrine is as strong as our navy and no stronger. Again to quote Darrieus:

> The formula, so correct in itself, but so often abused in France in its application, means that the determination of the naval forces necessary to a nation, the principal characteristics of the units composing these forces, and the actual bases of operations from which their action is to be supported requires previous knowledge, as complete as possible, of what may be termed the "constants" of the international situation.

FRENCH NAVY (12)

Summary of Organization of Navy Department



In England, being given an impetus by the writings of Mahan, the knowledge is widespread that the safety of the Empire hangs upon the efficiency of the navy for war. There is a national menace before the eyes of the people requiring, demanding ships and men, and making it imperatively necessary for the fleet to be ready for war.

In Germany, shut in on the land as she is, the nation knows that to breathe it must expand by the sea. The land frontiers are safe from attack, thanks to the marvelous and efficient army of citizen soldiers. The national menace must be therefore, by water, and the Emperor has received the unanimous backing of his people in his aim for an outlet, and in the creation of a great over-sea trade that will enrich and increase the world-power of the fatherland. All these factors together, I believe, have formed what Captain Rodgers terms the driving force behind the organization of the German naval establishment.

Turning again to France, the German Army has been its national menace. Upon the sea England has ever overshadowed her. The dream of sea-power for France has never been born. The national mind is centered upon the Grand Army. The inspiring conquests of the first Napoleon are yet cherished.

Public attention in France having been withdrawn for so many years from the navy, the naval heads have not acquired the incentive to have an efficient naval force for war. The principle of life is lacking and co-ordination of the interdependent parts of the organization is impossible without it. All the dangers of a highly concentrated *esprit de corps* are present, and promotion it is said depends more upon personal friendship than upon individual efficiency.

The French system in the administration of the Navy Department is by "directions" or bureaus, and under the system of government and without the *national peril* by sea, those bureaus which supply the wants of the navy, the civil branch of the organization, have acquired practical independence of their co-ordinating councils.

Captain Rodgers says on this point:

> A special body of technical officials manages the affairs of each direction, and the strong *esprit de corps* natural to such bodies causes a constant striving for independence which has had a large measure of success. The French organization has the faults of organization which the English Navy corrected seventy-five years ago when it abolished the Navy Board.

We must grant in any organization that the individuals are each and every one influenced by the desire to do their best work for the common good; but it is a frailty of human nature that men highly specialized along one branch in a profession are prone to resist interference from outside of their specialty, and more certainly from those less competent in their specialty than themselves.

The military branch of a naval organization for administration should be specialist in naval war, and the instruments of its specialty are battleships, cruisers, destroyers, submarines, torpedoes, mines, etc.

The civil branch is specialist in the manufacture and supply of these instruments for the use of the military branch.

The military branch must direct how the money given by the legislature for naval use is to be expended in order that the greatest war efficiency may be obtained. The civil branch must be free to manage its own specialties, and interference as to the *methods* of the civil branch is outside of the province of the military branch. Where fraud is known to be present in the administration of the civil branch and in consequence the military branch cannot obtain the true war value of the money legislated, then investigations, instituted and directed by the military branch, are necessary. This is only a law of military administration which is fundamental. The knowledge of fraud, corruption, inaction or inefficiency of the civil branch comes to the head of the organization through the inspection branch, and is a matter readily adjusted if, happily, there exists in the organization a means of exposing such conditions.

Reforms must be urged from outside the service. They may be conceived by officers inside; but unaided, their opinions are quickly throttled by those powerful in the service who honestly or dishonestly can see no virtue in change that disturbs the old and accustomed order. That this is true, the resistance of the Sea Lords of the Admiralty against the introduction of steam in the British Navy, advocated by the civilian First Lord, Sir James Graham, forms a striking example. Another example was the reforms made in French naval organization by Colbert, a civilian, against the opposition of naval men. An example in recent times in our navy was the reforms in gunnery methods, advocated within the service it is true, but backed by a power from the outside, the

President of the United States. Without this force the reform would likely have failed and its advocate would have been disciplined.

In the French organization for the administration of the navy there are three branches: The naval branch, headed by the Chief of the General Staff; the general administration or civil branch; and the inspection branch. All three branches are co-ordinated by the Minister of Marine, who is generally a naval officer, but may be a civilian.

The Minister of Marine is by law a member of the legislature; he has a Technical and Administrative Cabinet and also a Civil Cabinet. The administrative functions are administered by "services." The services spend money to provide and maintain the navy in efficiency, and the General Staff uses the navy in peace and war.

The French Navy has *not* been given a definite, well-matured building program of a fleet based upon the nation's policy. The French Navy has, therefore, no arrival point. Although the organization seems sound in principle, without the desire of the nation to have an efficient fleet for war, the directive force is lacking and the result in the past has not been to give the fleet the best administrative support.

Admiral Darrieus claims that the French nation understands the urgent need of a strong navy, but the direction remedial measures must take seems as yet unknown or at least as yet misunderstood. It seems likely enough that France has been unable to forget her many defeats upon the sea, which naturally causes apathy in the development of the navy, while the glorious traditions of her army spur her on to increased effort in the land defense.

HISTORICAL DEVELOPMENT OF UNITED STATES NAVAL ORGANIZATION FOR ADMINISTRATION.

From 1815 to 1842 the navy was administered by a Council, but in the latter year Congress repealed the law and created the bureau system of naval administration.

The business of the navy at first was placed in the hands of the following bureaus:

(1) Yards and Docks, (2) Construction, Equipment and Repairs, (3) Provisions and Clothing, (4) Ordnance and Hydrography, (5) Medicine and Surgery. These bureaus were intended

as administrative departments of the naval establishment, and in administering the navy, the chiefs of bureaus could issue orders in matters concerning their particular specialties, which orders were to be considered as emanating from the Secretary of the Navy. The distribution of duties to these bureaus was left at the discretion of the Secretary of the Navy. In 1862, three additional bureaus were authorized by Congress: (1) Equipment and Recruiting, (2) Navigation, and (3) Steam Engineering.

The general organization of the Navy Department has not changed materially since the latter date.

To sum up, from the pen of a well known writer:

> It is noteworthy that Congress and most Secretaries have always been unable to act on the principle that the navy exists for war. Apparently, Congress has been of the opinion that if money is honestly spent for the navy, the navy must be efficient. Thus Congress always has seemed more or less to resent and resents to-day, serious reference to professional opinion as to the direction in which naval appropriations should be spent. Congress has never grasped the idea that there is a great field of executive action with regard to the navy in which legislative control can only be disastrous, and hence Congress and most secretaries have hitherto always opposed development in the organization on the military side of the Navy Department.

A strong organization on the military side of the Navy Department is the only way to strengthen professional naval opinion as to the direction in which the navy's moneys should be spent, and must succeed in crystallizing views on military subjects which are now at variance, and concentrate all intelligence upon the known mission.

The navy's *mission* is to wage war successfully and in times of peace to keep itself "fit" for the task. The *mission* of naval administration, both in peace and in war, is to make possible the accomplishment of the navy's *mission,* in efficiently keeping the entire naval establishment prepared for instant war, and to furnish the fleet engaged in war with all the necessities for its task.

Serious reflection must convince even the casual reader that a lack of "scientific management" in our governmental methods lies at the root of unguided administration in our naval affairs. A body to advocate maturely reasoned-out policies for national defense has now no place in the organization of government. The responsibility for the national safety, and the *means* to preserve it, are not and never have been co-ordinated.

A NATIONAL BOARD FOR DEFENSE.

Lord Esher, in his report upon British Army reorganization, said:

We should, however, fail in our duty were we not clearly to define the urgent and vital importance of providing, in some shape or form, a permanent institution, charged with the duties and responsibilities of calling the attention of the Prime Minister of the day to strategic problems of defense, which are never constant, to the actual condition of our armaments, and to the relation which the latter should bear to the former if the King's dominions are to remain secure.

Again the report says:

At the outset of our inquiry, we are driven to the conclusion that no measure of War Office reform will avail unless it is associated with provision for obtaining and collecting for the use of the Cabinet all the information and the expert advice required for the shaping of national policy in war, and for determining the necessary preparations in peace. Such information and advice must necessarily embrace not only the sphere of the War Office but those of the Admiralty and of other offices of State.

Lord Esher again states a fundamentally important point in constituting such a committee:

The Defense Committee of the Cabinet, as now reconstituted, is intended to fulfill this imperative requirement; but we are convinced that further development is essential. A committee which contains no permanent nucleus, and which is composed of political and professional members, each preoccupied with administrative duties widely differing, cannot, in our opinion, deal adequately with the complex questions of Imperial Defense. The fact is that there is no one charged with the duty of making a continuous study of these questions, of exercising due foresight in regard to the changing conditions produced by external developments, and of drawing from the several departments of State, and arranging in convenient form for the use of the Cabinet such information as may at any moment be required. Failing the provision of such an equipment, we are convinced that the Government cannot be in a position to arrive at sound conclusions in regard either to the needs of war or to the preparations required in peace. We believe that the result has been, and must be, misdirected effort, involving risk on the one hand and waste on the other.

Where the responsibility for efficiency and sufficiency of preparation for war rests upon Parliament, and, in a special sense upon the Prime Minister, we hold that it is essential to provide the latter with adequate means of discharging his heavy obligations to the Empire. . . . .

There are no means for co-ordinating defense problems, for dealing with them as a whole, for defining the proper functions of the various elements, and for ensuring that, on the one hand, peace preparations are carried out

upon a consistent plan, and on the other hand, that in time of emergency a definite war policy, based upon solid data, can be formulated. It would be easy to show that unnecessary weakness coupled with inordinate waste of national resources thus results.

The above clearly expressed opinion of Lord Esher brought into existence a Permanent Committee of National Defense.

The report continues:

To the Defense Committee, acting as the co-ordinating head of all the departments concerned in the conduct of and in the preparation for war, we look to fulfill the main functions of a general staff, as they are now understood all over the civilized world by statesmen who have considered the necessities and conditions of empire.

The permanent nucleus of the Defense Committee should consist of:

I. A Permanent Secretary, who should be appointed for five years, renewable at pleasure.

II. Under this official two naval officers, selected by the Admiralty, two military officers chosen by the War Office. . . . . These officers should not be of high rank and the duration of their appointment should be limited to two years.

The duties of the permanent nucleus of the Defense Committee would be:

A. To consider all questions of imperial defense from the point of view of the navy, the military forces, India and the colonies.

B. To obtain and collate information from the Admiralty, War Office, Indian Office, Colonial Office and other departments of State.

C. To prepare any documents required by the Prime Minister and the Defense Committee, anticipating their needs as far as possible.

D. To furnish such advice as the committee may ask for in regard to defense questions involving more than one department of State.

E. To keep adequate records for the use of the Prime Minister, Parliament or for the Committee of National Defense itself.

Captain F. K. Hill, in a paper printed in the NAVAL INSTITUTE PROCEEDINGS some months ago, advocated a National Board for Defense, to be composed of:

Secretary of State.
Secretary of War.
Secretary of the Navy.
Chairman of Senate and House Military Committees.
Chairman of Senate and House Naval Committees.
Chief of Staff, Army.
President of Army War College.
Naval Aide of Operations.
President of Naval War College.
One Permanent Secretary, Civilian under State Department.

If to these are added two naval officers, two army officers and one or two *Permanent* Secretaries, to be taken from those versed in diplomacy, then we shall have a body fully qualified to give reasoned decisions upon all questions of the nation's military and naval policy.

Captain Hill further says upon the subject of the National Board for Defense:

> For the information of this board it is necessary to have as its head the Secretary of State, who knows about the diplomatic relations which may precipitate war; it is necessary to have the legislative members, so that they may decide on the policies to be carried out and the expenditures required to prepare for war; and it is necessary to have the military branches, which will furnish technical information as to preparation for war and from the discussion of the board will understand the policies to be enforced in the prosecution of war, and so draw the strategic plans that the object of the war may most fully be accomplished.

From the deliberation of such a board must flow a building program for the navy and such recommendations to Congress in regard to personnel and matériel as will permit the carrying out undisturbed of the *true aims* of the nation. This board cannot help succeeding in winning the entire confidence of Congress and the people; and then either the nation will move smoothly and peacefully along its chosen paths or else it will be armed and prepared to dispute by force its right of healthy, logical development along the lines which its destiny has pointed out.

THE RELATION OF THE STATESMAN TO NAVAL POLICY.

Admiral Darrieus has written: "In this terrible game of naval warfare, where the destinies of the nation constitute the stakes, the 'pieces' are represented by the various elements of naval force. (Battleships, armored cruisers, scouts, destroyers, submarines, naval bases, etc.) These must be disposed judiciously and used to the greatest possible advantage with reference to those of a *probable enemy*. This is *naval policy*."

Accurate knowledge of possible enemies and the probable *entente* and alliances is necessary in order to be able to choose judiciously our *arrival point*, which from the circumstances is ever moving away from us and for which we must be ever reaching to arrive upon the battle-ground at the decisive moment.

There must, therefore, be at the helm of State, to give the necessary information, the diplomat at head of government, in whose keeping are the secrets of the international situation, upon which our building program should logically be based. There we have exemplified the duties of the National Board of Defense advocated above.

Close relationship between the statesman, the naval officer and the legislature must be seen to be of vital necessity. The statesman points to the international situation on the political horizon, forecasting the future; the naval officer draws up the required building plan to insure a defeat of the probable enemy, in accordance with the strategy which would be compelled by the conditions. This plan, with the cost, is submitted to the legislature. This body has the privilege of decreasing the allowance as it sees fit, to the extreme of disallowing the entire plan.

If the amount appropriated by Congress is denied or reduced so that the fleet as a weapon of war will become totally inadequate to perform its mission if called upon by the statesman at head of government, or by Congress which wages war; it then becomes the stern duty of the head of the naval organization to emphatically announce to Congress and the statesman that the navy is not strong enough to form a backing to a national policy which may be challenged to the limit of war by certain powers.

If the amount appropriated is smaller than required, yet if there remains a chance for victory against *the* opponent with a view to whom the country's naval policy and building program are framed, then the aim of every naval officer and man must be to so perfect himself in mind and body, in study and war training, that this material handicap can be overcome.

In the case of a wholly inadequate navy, there can exist no incentive to prepare for a war in which defeat is inevitable; therefore, the entire organization becomes apathetic and is then on the high road to decay, incompetency and inefficiency.

A STRONG NAVAL POLICY AND A BUILDING PROGRAM.

"There is no military institution which is in more urgent need of foresight than the navy, for the difficulties in connection with personnel are coupled with the importance of matériel. Napoleon's strategy was defeated, due to lack in necessities. Cervera sailed

without ammunition and guns and without a base to refit. The Russian fleet was totally unprepared.

"Fleets cannot be created upon the eve of war."

A building program, even if it will still give us *material* inferiority to a probable enemy, an inferiority not too great for the naval mind to accept, will give to the entire naval organization an "*arrival point*," a possible tangible enemy, and will awaken every naval activity to strive to be ready with a known, definite force of ships, personnel and bases to refit, and to successfully engage the probable enemy in a selected war area. This will give to the organization the *principle of life* sorely needed, co-ordination under a plan, and our organization can be stirred to life in no other way. A building program must cover a term of years and will involve an initial expense that will surprise our national legislators.

Admiral Darrieus, in writing on French organization, says: "The creation of a fleet, one must never be tired of reiterating, should always be based upon concrete hypothesis." *Upon what hypothesis are two battleships a year?* "The choice of our fleet, and of the number and quality of the vessels of which it is to be composed, is decided solely by sentiment and according to the too frequent changing ideas of the moment." This is too true of our own naval policy to be pleasant reading. "From whatever side the problem is regarded, the insufficiency of our naval effort is obvious. We cannot fulfill our naval obligations . . . . The latest terms of our naval program do not give us from any point of view the '*fleet of our policy.*'"

Necessity, public necessity, is the ultimate driving force. Rising like a tidal wave, it will sweep away the strongest opposition, level partisan opinions and sternly bid the government servants seek for fundamental truths. Until this necessity is recognized, the task of awakening responsive action will be hopeless. Nevertheless, the navy's duty in creating a hinterland of reasoned opinion upon the needs of reform is evident. When the day comes for this action, the consciousness of loyal effort will be a sufficient reward.

In this task of creating reasoned opinion, all effort must be focused upon the true requirements of our professional organization—an organization reared upon a foundation of natural laws, inspired with perfect co-ordination under a plan. Such an organization cannot fail to give the maximum *force* for the minimum expenditure of the nation's money.

CONSTRUCTING A THEORETICAL ORGANIZATION FOR NAVAL ADMINISTRATION.

After considerable investigation and study upon the subject of organization for naval administration, a conclusion has been reached that if we are ever to attain war efficiency, in time of peace, two fundamental changes must be made in our departmental organization. By war efficiency is meant not only the isolated efficiency of fleets and squadrons, but that efficiency combined with efficient supply of war necessities to carry out hostilities. "In time of peace" has been used purposely, because it is quite certain that the exigencies of war will force these necessary changes and, depending upon the comparative war efficiency of our enemy, our own efficiency may ultimately be accomplished.

These requisites are: (1) the appointment of *one* naval officer of sufficient rank, and with capabilities beyond the average, to shoulder the military responsibility of the preparedness of the fleet for war. (2) The creation of a General Staff.

It is firmly believed that until these two reforms are made no lasting improvement in the preparedness of the navy for war can result, nor will officers be trained in sufficient numbers in the "art of war"—the profession of the military naval officer, so long neglected in this country.

THE PRINCIPAL NAVAL ADVISER.

This officer should be the Principal Naval Adviser to the Secretary of the Navy and should be further the *immediate head* of the Naval General Staff.

THE NAVAL STAFF.

A *Naval Staff* or *General Staff* would be a body of *sea-going* officers on temporary shore duty, under the immediate supervision of the *one* Principal Adviser, charged with drawing up and preparing possible plans of operations; with arranging for the strategic concentration of the fleet; with knowing and estimating the strength of possible enemies; with the study of theaters of war; and with the study of and preparation of charts of harbors that may have more or less military value in war.

The Naval Staff would deal also with the study of the art of war, especially military history and the training of officers in the

duties of the Naval Staff. A Naval Staff officer should be familiar with all sides of the naval profession.

The inspection of the war maneuvers of the fleet would be a duty of the Naval Staff. Through these inspections the efficiency for battle of the higher officers of the service will be known and their promotion to responsible positions determined.

The War College should furnish the means by which the entire service—*officers of all corps*—can be trained in the art of naval war. The Naval Staff must be constantly receiving an infusion of new blood. Two years away from the fleet is a long time in these progressive days and should be the maximum for service on the Naval Staff. The only requirement necessary for the duty on the Naval Staff should be a willingness to become familiar with the great principles of the art of war and the skill to apply those principles to the needs of the naval service.

The following quotations upon the Army General Staff are taken from General Von Schellendorf's "Organization of the German General Staff."

The below remarks of course refer only to those officers trained in General Staff work at the General Staff headquarters and detailed to the staffs of generals in the field.

Apart from the fact that the mental and physical powers of one man, the general-in-chief, are not equal to such a task, the comprehensive supervision of the forces under his command would suffer.

In some armies all the staff belongs to the General Staff. But a necessity has universally been felt of having a distinct portion of the staff entrusted with planning and carrying out the movements of armies in the field, and it is generally distinguished by some special name. This particular branch of the staff of a general holding an important command is known in the German Army as the General Staff.

Officers of the General Staff are vested with no military command; it is only the general who commands and is responsible. The officers of the General Staff must be his devoted and confidential counsellors. This necessitates the general having absolute confidence in his assistants. As a General Staff officer must deny himself the true military instinct of wishing to take command in accordance with his rank a good General Staff officer is, therefore, certainly not asking too much if he claims the complete confidence of his general, and the grant of a certain amount of independence in the details of his duties. Otherwise, he would feel at once that his post might be better filled by an inferior person and himself more advantageously employed at regimental duty.

A General Staff officer cannot excuse himself of any neglect on his part on the plea that no order on the subject had been given him by the general. He should only consider himself freed from responsibility when his sug-

gestion has been declined by the general. This gives no small measure of responsibility to the General Staff in war, and necessitates untiring energy.

The peace duties of the General Staff should prepare it for its duties in war. General Staff officers with commands have to work out in peace all matters of mobilization, movements, quarters, maneuvers, railways and information.

Careful and painstaking investigations of individuals in special subjects should be looked upon as the common property of all. Everything should work collectively to the attainment of a common result, and this is: to ascertain from the study of the history of war the principles of leading troops both to and during battle, arriving herein at clear and independent conclusions. It is not a means to an end, but the end itself, the knowledge of all that the study of military matters and experience can teach.

The following points constitute the main principles on which the present efficiency of the Prussian General Staff is secured:

1. The independent position in the organization of the army.
2. The appointment to the General Staff is restricted to no clearly defined claims.
3. The absolute freedom of its military scientific training.
4. The compulsory return of its officers from time to time to regimental duties.

The Chief of the Naval Staff of the fleet and his assistants would have the following general duties in war or during maneuvers simulating war:

1. Working out all arrangements for anchoring the fleet in harbor. Security of the fleet in port or sea. The formations for cruising night and day. The general plans for a prospective battle.

2. Communicating the necessary orders either verbally, by radio or in writing, at the right time and place, and in sufficient detail.

3. Obtaining, collecting and compiling in order all information concerning the nature and military character of the theatre of war, providing maps and plans.

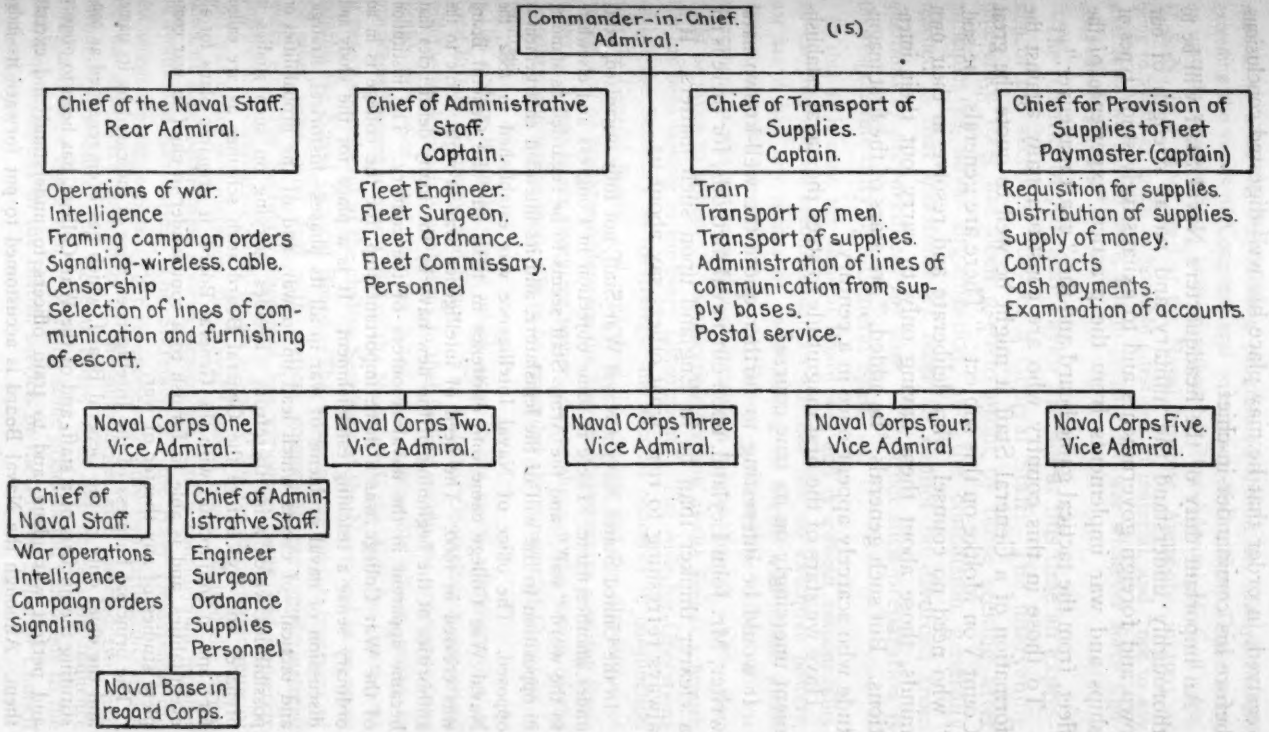
4. Collecting and estimating the value of information received concerning the enemy's forces.

5. Watching over the fighting condition of the vessels and keeping himself posted as to their efficiency in every respect.

6. Keeping journals and diaries, drawing up reports on engagements, and collecting important materials for the subsequent history of the war.

7. Special duties, particularly scouting and reconnaissances and estimating the situation as new information of the enemy is

(15)


Commander-in-Chief.
Admiral.
Chief of the Naval Staff.
Rear Admiral.
Operations of war.
Intelligence
Framing campaign orders
Signaling-wireless, cable.
Censorship
Selection of lines of communication and furnishing of escort.
Chief of Administrative Staff.
Captain.
Fleet Engineer.
Fleet Surgeon.
Fleet Ordnance.
Fleet Commissary.
Personnel
Chief of Transport of Supplies.
Captain.
Train
Transport of men.
Transport of supplies.
Administration of lines of communication from supply bases.
Postal service.
Chief for Provision of Supplies to Fleet
Paymaster. (captain)
Requisition for supplies.
Distribution of supplies.
Supply of money.
Contracts
Cash payments.
Examination of accounts.
Naval Corps One
Vice Admiral.
Naval Corps Two.
Vice Admiral.
Naval Corps Three
Vice Admiral.
Naval Corps Four.
Vice Admiral
Naval Corps Five.
Vice Admiral.
Chief of Naval Staff.
War operations
Intelligence
Campaign orders
Signaling
Chief of Administrative Staff.
Engineer
Surgeon
Ordnance
Supplies
Personnel
Naval Base in regard Corps.

received, in order that he may place his well-digested conclusions before his commander-in-chief.

An important duty of the headquarters Naval Staff will be to thoroughly understand the military and naval strength of our own and foreign governments and to exhaustively study types of ships and war implements from the practical experience of the fleet, from the tactical game board and the "chart maneuver."

To those in this country who are constitutionally against the formation of a General Staff it might be well to quote the great Count Von Moltke on this subject: "There are generals," he said, "who need no counsel, who deliberate and resolve in their own minds, those about them having only to carry out their intentions. But such generals," he added, "are stars of the first magnitude who scarcely appear once in a century."

Have we stars of the first magnitude to steer the naval establishment unerringly on its true course?

It would be interesting to further quote the well-known naval writer, Mr. John Leyland, upon our naval methods, for there is not a clearer thinker than he in England upon such matters. It is always refreshing to read what others say about us.

In the United States Navy a Naval War Staff, not fully organized, exists under another name. There is some objection in Congress and elsewhere to the word "staff," and the Army Staff seems to be regarded as standing in opposition to the will of the legislature, and its intended enlargement is opposed. The office of Naval Intelligence was established in 1882; the Naval War College came into existence in 1884, and the General Board was created in 1900. The need of intelligence was brought home to the authorities at the beginning of the new navy by the many deficiencies that became apparent in the naval resources of the country. The institution of the War College was a more important step, for the college is in no ordinary sense a teaching establishment. It is a place for the study and discussion of naval problems of war in all its phases—historical, strategic and tactical—of events which lead up to war, and of the probabilities or possibilities which arise therefrom. Besides carrying on such studies, it prepares and lays before the General Board such schemes as are called for; and in conjunction with the General Board, it prepares plans for all eventualities, and is able to furnish to a commander-in-chief in war complete studies of any theater of war.

The principal business of the Intelligence Office is indicated by its name, and the chief duty of the General Board, which has been regarded as constituting the nucleus of a staff, and of the War College, has been to prepare and perfect war plans, and to train officers to understand and execute them. Although the Naval Board is accustomed to put forward its judg-

ment as to what the shipbuilding programme should be, always therein exceeding the views of Congress and sometimes of the Navy Department, its function was, perhaps, best described by Rear-Admiral H. C. Taylor, U. S. N., in a paper read at the Naval Institute, Annapolis, in 1903, as being to avoid as much as possible questions of material, and "not to say what force we should have, but to prepare for war whatever force Congress should give us."

The remarks of Admiral Taylor are not at this time an expression of the accepted duty of a General Staff. The intervening time since 1903 has been used to profit by those seeking after principles of naval organization, and the conclusion generally reached is that *questions of material* cannot be divorced from *questions of preparedness for war.* To direct such preparation is the responsible duty of a General Staff.

Be this as it may, the General Board was and is without responsibility for carrying out its recommendations. It has had no executive powers, nor has it had any means of co-ordinating its views with those which emanate from the bureaus. When Mr. Meyer instituted the "aides" for his department, it was with the idea of creating a means through which effect might be given to policy. "An operating division of the fleet is a branch that has been lacking in the Navy Department." The Aide for Operations advises the Secretary as to strategic and tactical concerns in conjunction with the General Board, and regarding movements and the disposition of vessels, and he prepares orders for the Secretary's signature covering these matters. There is no executive power, except through the action of the Secretary, and where money is to be expended the consent of Congress is required.

This system is unlike those which exist in the naval administration of Great Britain, Germany, and France. The Aide for Operations is concerned with the work which is analogous to that feeling within the province of the British First Sea Lord, but the latter is a responsible officer, acting in practice as Commander-in-Chief of the Navy, while the Aide for Operations is merely an assistant of the civilian Secretary of the Navy, and in no sense controls the Naval General Board. The same is true of the functions of the other aides, who deal with matters concerning personnel, material works, etc. The Secretary, therefore, has various advisers, and is merely assisted in co-ordinating policy by his aides. When the naval programme of 1911 was under consideration, the Naval General Board advised the laying down of four battleships, sixteen destroyers, and a considerable number of scouts and auxiliaries. The Secretary and the Navy Department did not accept the suggestion. They recommended only two battleships, struck out the destroyers, and most of the auxiliaries, and inserted two submarines. Therefore, the General Board does not necessarily influence policy, and there appears to be wanting some organization analogous to the Board of Admiralty in the British service, or the French Superior Council of the Navy.

The new system in the British Navy is the outcome of tradition and experience, and certainly is more efficient, as a salutary means of bringing to bear the influence of mature thought upon all naval problems that may arise, than any of the systems that have been examined. In Germany, everything turns upon the final executive power of the Emperor. In France, the Chief of Staff occupies a position analogous to that of the British First Sea Lord, but he is directly subject to the Minister; his authority and functions are not the same, and the organization of the sections of his department is confused with administrative and executive duties, owing to the want of an organic system for co-ordinating the duties of administration and command. In the United States the existence of a strong bureau system operates against the position and influence of the General Board, and gives the Secretary a great many advisers, in dealing with whose counsel he has sought the assistance of "aides," whose position he is now seeking to establish by legislative enactment.

NAVAL SCIENTIFIC MANAGEMENT.

Scientific management for the navy, in its essence, might be said to consist of a "certain philosophy which results in a combination of the four great underlying principles of management:"

(a) The development of a true science of naval administration.

(b) The scientific selection of men to control the divisions and subdivisions of the organization.

(c) The scientific education and development of all the personnel of the navy.

(d) Co-ordination under a plan between the fleet and the naval administration behind it.

The Naval Staff will form the planning section of the organization for administration of the navy. The primary object, it has been frequently stated in this paper, is the preparation of the fleet for war and its support during the war, but, secondarily, naval administration must endeavor to maintain the navy economically, in order that the limited appropriations of money may give the greatest efficiency to the existing naval force. In short it must endeavor by concerted action to develop progressively the naval arm to be equal to the task of defending the nation's avowed foreign policies by holding the fleet always ready to take the offensive within the probable theater of war.

To be able to accomplish this task there must be:

1. Detailed strategic and logistic plans for each given theater of war against a particular enemy.

2. Detailed administrative plans to make the strategic and logistic plans possible of execution.

Upon these plans the details within our organization must be based.

In order that (1) and (2) may be put into immediate execution after hostilities are imminent, it will be necessary to fulfill the following:

(a) There must be in readiness a well-balanced fleet, at least equal, within a probable theater of war, to a possible opponent.

(b) No vessel should be classed as available for war against a first-class naval power unless it has on board at least *two-thirds* of its full complement of officers and men, fully supplied and *fully trained for battle.* Reserve ships, as understood in this country with one-third crews, *cannot* be considered available during the course of a short, decisive naval war.

(c) *All officers* must be trained in the art of naval war and should be bound together by a common *doctrine* in the *conduct* of naval war.

(d) The method of supply and transport must be adequate, or in other words the naval administrative backing must be as efficient as is possible to make it before the war, and be able to continue without check or change during the continuance of hostilities. Officers holding administrative positions should *not* be relieved to join the fleet; their importance as links in the chain of administrative organization cannot be too strongly emphasized.

(e) Within the theater of war as well as at home there must be suitable bases for refit—fortified and stocked with provisions and supplies, including ammunition and coal for use of the fleet for a limited period. Advance-base outfits for temporary bases must be supplied complete, with the personnel to operate them.

Our organization for naval administration must be constructed to give free effect to every effort required to provide the fleet with the above vital necessities.

NAVAL APPROPRIATIONS.

The next reform of importance should be to follow, as near as our form of government will permit, the British plan of appropriations for the naval establishment. (See article in NAVAL INSTITUTE PROCEEDINGS by Pay Director Hunt.)

The Secretary of the Navy, acting through carefully weighed

advice from his technical assistants, should be given discretionary power to spend the money and further to adjust the money balances between different specific "votes." He should be able through Treasury sanction, or through sanction from the Naval Committee of Congress, to use money for purposes other than those for which appropriated, provided to do so would, in the opinion of his trusted principal *Adviser*, enhance the *efficiency of the fleet for war.*

Lord Esher has said:

> The question of finance lies at the root of War Office administration. Upon the proper adjustment of responsibility between the spending and the accounting branches must depend alike the efficiency of the forces and the safeguarding of the tax-payers' interests.

If the budget system could be adopted and the naval appropriations be divided under general headings instead of being exhaustively itemized, as now obtains (there were two hundred and forty items in our last appropriation bill), much greater efficiency in administration could thereby be effected.

Lord Esher again says:

> The theory that military officers of all ranks are, by the fact of wearing uniform, shorn of all business instincts has inevitably tended to produce laxity which it is supposed to prevent. When money is doled out in compartments and no discretion as to allocation is permitted, savings are not likely to accrue.

The British form of appropriation bill would not relieve the executive department of the navy from financial obligations. Every dollar would have to be accounted for and Congress could at any time inspect the accounts of the navy and find where every dollar was spent.

The budget form of naval appropriations was assumed to exist in the organization of the Navy Department here outlined, and this compelled the creation of the Division of Finance.

NAVAL ADVISERS TO THE SECRETARY.

It has been stated as an invariable principle that responsibility must be *individual*, and that the Secretary of the Navy, being a civilian, and therefore unversed in the technical details of administration, must depend upon his advisers for such technical help as he may require to efficiently administer the naval establishment.

To satisfy this principle the *one Principal Adviser* must stand between the subordinate advisers and the Secretary as does the executive officer on board a warship to his captain, and be held responsible by the civilian Secretary for the preparedness of the fleet for war.

The number of advisers should be such that the various kindred subjects can be grouped together under one head. To give one adviser many dissimilar duties must lead to the neglect of some.

Kindred subjects should be grouped together under a single management, so that divisional heads of offices have charge of related matters in an ascending series of increasing complexity, with an unbroken chain of responsibility existing from the lowest to the highest official.

In Diagram 13 an attempt has been made to construct an organization for the administration of the navy, based upon principles stated in the preceding pages.

It is offered merely as a study and the opinion of the service upon it is freely invited.

It will be necessary to more exactly define the status of an adviser, an official so frequently spoken of in this paper.

The members of the Cabinet are the President's advisers. They are also executive heads of the various departments of the government. The Century Dictionary and Encyclopedia states that the President " requests the opinion of his Cabinet in accordance with custom but not through any provision of the Constitution." In England, the members of the Ministry are advisers to the ruler. Yet in this case the responsibility rests with the Ministry and not with the sovereign.

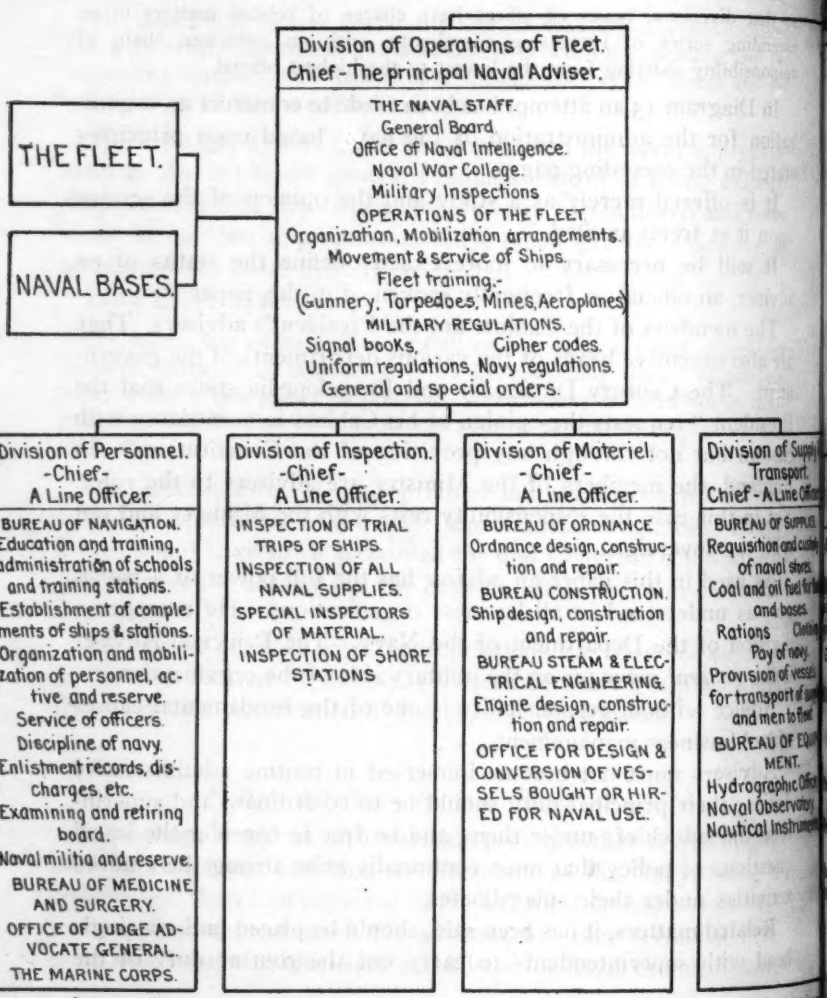
As used in this paper an *adviser* has the full power of a *manager*, as understood in all business organizations. He manages a division of the Department of the Navy. The Principal Adviser is the *general manager* on the military side of the organization.

Advice without responsibility is one of the fundamental causes of bad business management.

Advisers must not become immersed in routine administrative duties; their principal duty should be to co-ordinate and superintend the sub-chiefs under them, and be free to consider the broad questions of policy that must continually arise among the kindred activities under their subordinates.

Related matters, it has been said, should be placed under a single head with superintendents to carry out the routine duty of the

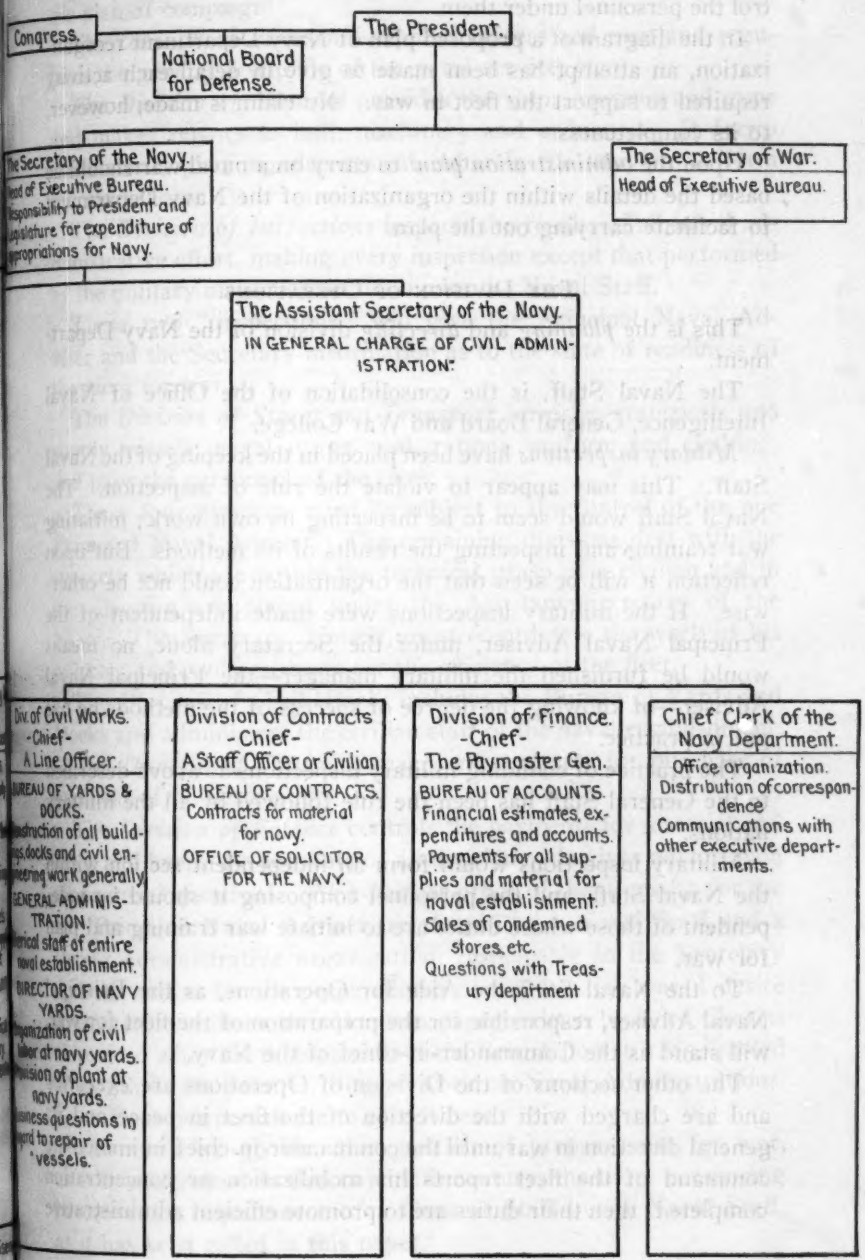
PROPOSED ORGANIZATION



NOTE:- "The Principle of undivided responsibility would dictate that ONE only of the [Naval Advisers] should be responsible for the advice given to the common superior - The Secretary."

Moody Board's Report

FOR ADMINISTRATION. (13.)


Congress.
The President.
National Board for Defense.
The Secretary of the Navy.
Head of Executive Bureau.
Responsibility to President and Legislature for expenditure of appropriations for Navy.
The Secretary of War.
Head of Executive Bureau.
The Assistant Secretary of the Navy.
IN GENERAL CHARGE OF CIVIL ADMINISTRATION.
Div. of Civil Works.
-Chief-
A Line Officer.
BUREAU OF YARDS & DOCKS.
Construction of all buildings, docks and civil engineering work generally.
GENERAL ADMINISTRATION.
Clerical staff of entire naval establishment.
DIRECTOR OF NAVY YARDS.
Organization of civil labor at navy yards.
Division of plant at navy yards.
Business questions in regard to repair of vessels.
Division of Contracts
-Chief-
A Staff Officer or Civilian
BUREAU OF CONTRACTS.
Contracts for material for navy.
OFFICE OF SOLICITOR FOR THE NAVY.
Division of Finance.
-Chief-
The Paymaster Gen.
BUREAU OF ACCOUNTS.
Financial estimates, expenditures and accounts.
Payments for all supplies and material for naval establishment.
Sales of condemned stores, etc.
Questions with Treasury department
Chief Clerk of the Navy Department.
Office organization.
Distribution of correspondence
Communications with other executive departments.

particular specialty, and these heads must have the power to control the personnel under them.

In the diagram of a proposed plan of Navy Department reorganization, an attempt has been made to give in detail each activity required to support the fleet in war. No claim is made, however, to its completeness.

Upon the *administration plan* to carry on a naval war should be based the details within the organization of the Navy Department to facilitate carrying out the plan.

THE DIVISION OF OPERATIONS.

This is the *planning* and *directing* division of the Navy Department.

The Naval Staff, is the consolidation of the Office of Naval Intelligence, General Board and War College.

Military inspections have been placed in the keeping of the Naval Staff. This may appear to violate the rule of inspection. The Naval Staff would seem to be inspecting its own work; initiating war training and inspecting the results of its methods. But upon reflection it will be seen that the organization could not be otherwise. If the military inspections were made independent of the Principal Naval Adviser, under the Secretary alone, no means would be furnished the military manager—the Principal Naval Adviser—of knowing the degree of success of the methods he has put in practice.

The practice of confiding military inspections as above described to the General Staff has been the rule followed by all the military nations.

Military inspections would form an independent section within the Naval Staff, and the personnel composing it should be independent of those whose duties are to initiate war training and plan for war.

To the Naval Staff the Aide for Operations, as the Principal Naval Adviser, responsible for the preparation of the fleet for war, will stand as the Commander-in-Chief of the Navy.

The other sections of the Division of Operations are *executive* and are charged with the direction of the fleet in peace and its general direction in war until the commander-in-chief in immediate command of the fleet reports his mobilization or concentration completed; then their duties are to promote efficient administrative

support to the fleet's operations, necessary to carry out the strategic plan of compaign.

The *Division of Personnel* supplies officers and men and regulates the general discipline of the naval service, etc.

The *Division of Matériel* provides the ships, engines and guns and makes repairs to hull, machinery and ordnance. It forms the matériel planning department, wherein the navy-yards form the workshops.

The *Division of Inspections* inspects the results of all naval administrative effort, making every inspection except that performed by the military inspection section under the Naval Staff.

These two "inspections" will give the Principal Naval Adviser and the Secretary information as to the state of readiness of the navy for war.

The *Division of Stores and Transport* furnishes transports and supply vessels, naval stores, coal, rations, uniform and clothing, and pays the personnel of the navy.

These four divisions must be subject to the control of the one Principal Naval Adviser. The remaining divisions deal with the subjects which are within the technical grasp of a civilian and in the diagram are placed under the Assistant Secretary of the Navy. The Secretary, himself, must co-ordinate the work of his military and civil assistants for the efficiency of the fleet.

The *Division of Civil Works* includes the Bureau of Yards and Docks and administers the civilian staff of the naval establishment.

The *Division of Contracts* makes all contracts for purchase of material of all descriptions.

The *Division of Finance* controls the payments for material and labor and keeps the accounts of all divisions. It gives advice upon all financial questions. As a further proof of the necessity for the one Principal Naval Adviser, reinforced by a Naval Staff and a strong administrative organization, responsible to the Secretary and the nation for the preparedness of the fleet for war, I desire to invite the reader's attention to a paper written by Lord Charles Beresford after the mobilization of the British fleet in 1885, quoted at length in Sir John H. Briggs' work on Naval Administrations. Space does not permit me to give it here.

The more we go into the question of preparedness for war, as it is understood in this twentieth century, the more convincing becomes the requirement of a General Staff—or a Naval Staff, as it has been called in this paper.

The Naval Staff must comprise the personnel capable of preparing plans for war—the General Board and the Office of Naval Intelligence; and an institution to train officers for Naval Staff duties—the Naval War College. Yet there must be accomplished in addition to amalgamation another fundamental requirement if this new organization is to be capable of performing the functions for which it is to be created. It must be placed under the direction of the Principal Naval Adviser and in close sympathy with him; in other words, he must be the Chief of the Naval Staff. The Naval Staff will form a part of his own brain, as it were; and in this way, through him, will gain the loyal support of the naval service and the Secretary of the Navy. To switch it off into a vest pocket of departmental organization will as effectually stifle the amalgamation as have been stifled since their incipiency, the several bodies which together are capable of giving us plans for war.

DECENTRALIZATION.

Any system of reorganization for naval administration, to be effective, must carry with it the necessary decentralization of duties and responsibilities. Centralization is *a peace-time growth* and can last only during the continuance of peace. Upon the outbreak of war, officers will have thrust upon them grave responsibilities to accept and act upon, for which they have never been trained. Confusion, indecision and failure can be the only outcome.

In a centralized organization subordinates are denied the right to act. They may recommend only; while those higher up—the Navy Department—act in ignorance of details too numerous and varied for them to have an intelligent understanding. The volume of paper work is an indication of the methods of an organization; congestion of paper work indicates a centralized control without a doctrine binding together the subordinates while small paper work shows a decentralized control through subordinates bound together by doctrine.

Centralization at the Navy Department without doubt not only lessens the efficiency of the personnel of the service but also the total efficiency of the navy. The impossibility of obtaining consistent action, in conformity with the Department's policy, from commanders of fleets, captains, commanders and commandants, is said to be the reason for the ever-increasing centralization.

Whenever a fault has been committed, by a subordinate officer, the Department has immediately issued a regulation covering the incident, and the consequence is that there exists a voluminous book of regulations to guide the navy, to be strictly followed to the letter.

The British Army, before reorganization after the Boer War, suffered from a like evil.

The Lord Esher Report says:

> The deleterious results of our centralized system of army control are, to destroy initiative; to bring up officers in peace time to refer everything to superior authority to shun responsibility. The consequence is, to tie organization up in the toils of excessively complex and minute regulations, drawn up without regard to *essential* requirements of modern war and needing expert interpretation.

Even though at first it is difficult to obtain consistent action from subordinates, centralization is not the remedy. The causes of inconsistency lie usually in a lack of co-ordinated military education and organization. Administrative faults are censured by the Department, but military faults are passed over unnoticed because there are none to recognize the errors. Co-ordinated organization and education are required before decentralization will show its true value in promoting the efficiency of the whole.

FLEET ORGANIZATION.

This paper is essentially a study of the principles of naval administrative organization. Yet a few words upon fleet organization, or the organization for the command of the naval forces, to invite attention to principles which influence each, cannot be resisted.

It may have been seen that many of the principles stated at length in this paper are applicable to fleet organization. Yet there many other points involved upon which up to the present time no maturely reasoned decision has been made.

Co-ordinate military education and training, doctrine, co-ordination under a plan, scientific management, decentralization—all these are the highroads to efficiency; each must be fused into the organization of individual intelligences composing the fleet.

In any kind of fleet organization prepared, the following qualities must be carefully examined:

(a) The tactical efficiency resulting.
(b) The administrative efficiency resulting.
(c) The efficiency of the organization for training.

The organization should primarily lend itself to be tactically handled with facility in battle; secondly, be in such form as to allow efficient administration; and thirdly, be in such form as to be easily and smoothly divided for war training.

The following fundamental rules should not be violated:

1. The greatest number of battleships that can be handled by one man in battle should be the smallest tactical unit.
2. Similar types should be grouped together.
3. The peace organization must be the war organization.

Admiral Darrieus has said: *"Mobilization should be permanent, a vessel in reserve cannot be created into a living thing before the end of the war."* Ships are too complex. The creation of an efficient personnel, the soul of the ship, requires almost half as much time as to build the ship itself.

DISCUSSION.

Organization for Navy Department Administration.

REAR-ADMIRAL B. A. FISKE, U. S. Navy.—The plan of naval administration suggested by Commander Stirling seems the ideal plan. Whether we shall be able to have such a plan adopted in practice is another matter. It is very similar to the plan now used by the War Department.

The whole question of administration in any organization is merely a question of division and subdivision of work. In a perfect plan of administration, every man, from top to bottom, would be allotted just such work as he could the most intelligently and efficiently do; and the total work to be done would be done without friction, and without the interference of anybody in anybody else's work.

In the present administration of the Navy Department, the Secretary signs a great many papers of a purely technical nature, the full purport of which he cannot understand. He is responsible for every paper which he signs; and yet it is obviously unfair to hold a man responsible for doing a thing which he is compelled by law to do, but which he cannot understand. It would seem better if a system could be adopted whereby the signing of purely technical papers, and the giving of purely technical orders, would be done, under general instructions from the Secretary, by technical men, who would be held responsible if the papers or orders were technically faulty.

Unfortunately, the feeling in Congress, and among civilians generally, is against carrying out such a scheme as Commander Stirling's, because of the feeling that such a system would rob the Secretary and the civil government of some of their power. This feeling, while mostly found among civilians, is found even among military and naval officers, because it is hard for men to realize that permitting a subordinate to have authority in his own little domain does not rob his superior of any of his authority. This statement is substantiated by the fact that it has been found necessary to place in the Navy Regulations a positive order that a flag officer must not interfere in the interior management of his flagship.

There seems no more reason why technical officers in the Department should not have responsibilities such as Commander Stirling suggests, than why the commander-in-chief of a fleet, the commandant of a navy-yard, or the captain of a ship should not have similar responsibilities. Nobody pretends that the powers given to a commander-in-chief, a commandant or a captain are taken away from the Secretary of the Navy; so why should any similar powers, even if exercised within the Navy Department itself, under the general direction of the Secretary, rob him of any of his power?

It would seem that, if Commander Stirling's plan could be carried out, we should have a plan whereby every act would be performed by the man responsible for that act; the Secretary would be freed from a great deal

of trifling work; his mind would be left free to study many large matters of naval policy that are now neglected; he would have time for conferring with congressmen, diplomats, and statesmen on national and international questions; would be, in fact, the director of a great department of the government, and wield a power that cannot be wielded now.

NAVAL CONSTRUCTOR T. G. ROBERTS, U. S. Navy.—*The German Organization.*—The most striking feature of Commander Stirling's paper is his exposition of the German naval organization, which I have not seen published heretofore. From appearances, line officers seem to dominate in practically all the branches, including shipbuilding and repairs, although, from inquiries which I have made, the actual conditions would appear to be quite different from what one would expect them to be from the exhibition on paper. Herewith is shown in Figs. 1 and 2 the organization of the Dockyard Department of the Marine Amt (Navy Department) and of the German navy-yards, as constructed from the information contained in published reports, and which may be taken to supplement the information contained in Commander Stirling's paper. It is seen that the Dockyard Department is in itself a little navy department within the Navy Department, having its own staff subdivided into nine sections, being apparently independent and self-contained. This appears to be an extreme case of centralization of control of dockyards and dockyard work. The British Office of the Director of Dockyards does not appear to carry nearly so much organization within itself. There are many cogent reasons why we should avoid the complexities of the German dockyard organization. Our own navy-yard organization as it existed prior to the Newberry plan, with its five separate industrial departments, was no worse in point of complexity of subdivision or in duplication of plant and machinery than the German organization now appears to be, and the latter is seen to contain the very conditions which it was the express purpose of our recent reorganizations to correct. I might mention in this connection that the British dockyard organization contains many of the same complications, though in less degree. No one in this country would be likely to recommend that we go back to the condition of organization we discarded in 1909, much less that we adopt a scheme containing more of the same class of elements. Our own movement towards a simplified organization consolidated into a single industrial unit has followed American rather than European practice, and we would retrograde many years if we should go to Germany for lessons in industrial organization and management. Mr. Fred W. Taylor has stated, with respect to the steel industries of this country, that the management is twenty years in advance of their European competitors.

By the above remarks I have referred to the German organization in order to make clear that we have been going in the opposite direction now these two reorganizations back, and can safely afford to dismiss it from our minds for all practical purposes.

The Essayist's Plan.—I will now address myself briefly to the organization proposed by the essayist (pp. 494-495), merely indicating conclusions without unnecessary elaboration.

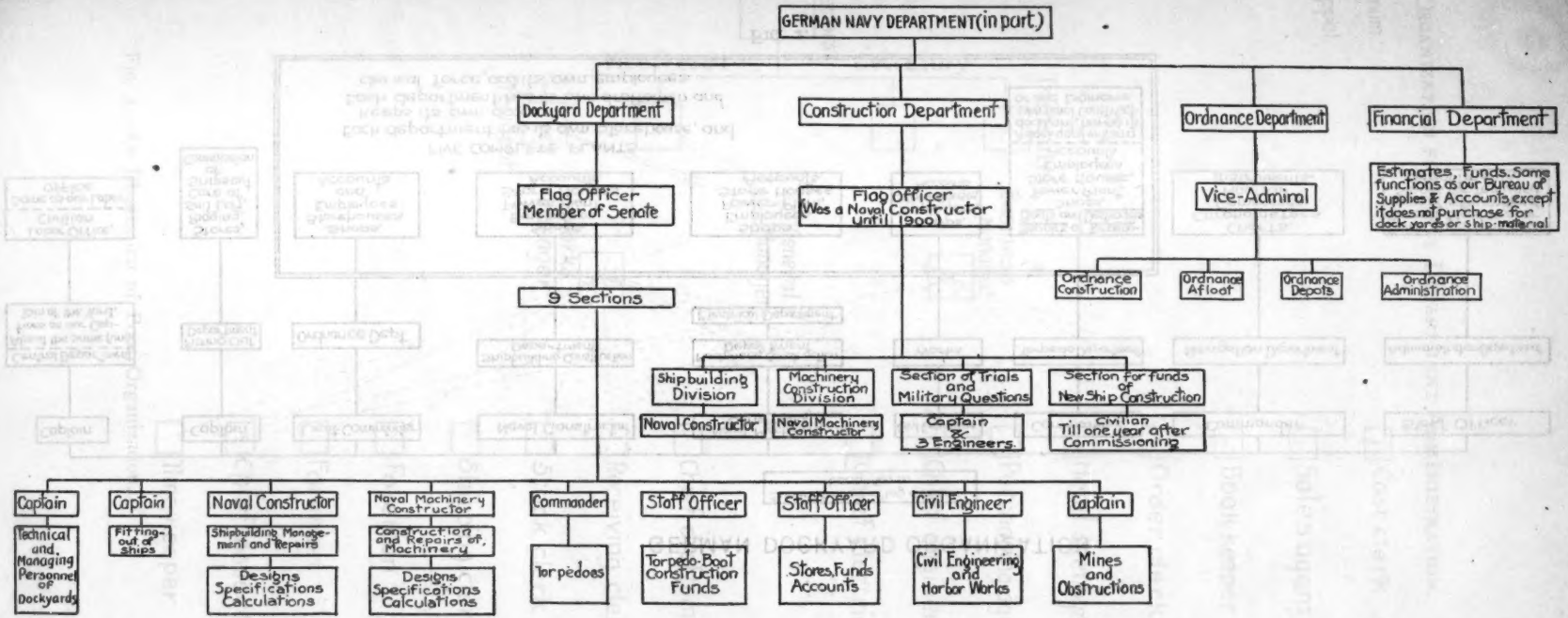

GERMAN NAVY DEPARTMENT (in part)
Dockyard Department
Construction Department
Ordnance Department
Financial Department
Flag Officer Member of Senate
Flag Officer (Was a Naval Constructor until 1900)
Vice-Admiral
Estimates, Funds. Some functions as our Bureau of Supplies & Accounts, except it does not purchase for dock yards or ship material
Ordnance Construction
Ordnance Afloat
Ordnance Depots
Ordnance Administration
9 Sections
Shipbuilding Division
Naval Constructor
Machinery Construction Division
Naval Machinery Constructor
Section of Trials and Military Questions
Captain & 3 Engineers
Section for funds of New Ship Construction
Civilian Till one year after Commissioning
Captain
Technical and Managing Personnel of Dockyards
Captain
Fitting-out of ships
Naval Constructor
Shipbuilding Management and Repairs
Designs Specifications Calculations
Naval Machinery Constructor
Construction and Repairs of Machinery
Designs Specifications Calculations
Commander
Torpedoes
Staff Officer
Torpedo-Boat Construction Funds
Staff Officer
Stores, Funds Accounts
Civil Engineer
Civil Engineering and Harbor Works
Captain
Mines and Obstructions

FIG. 1.

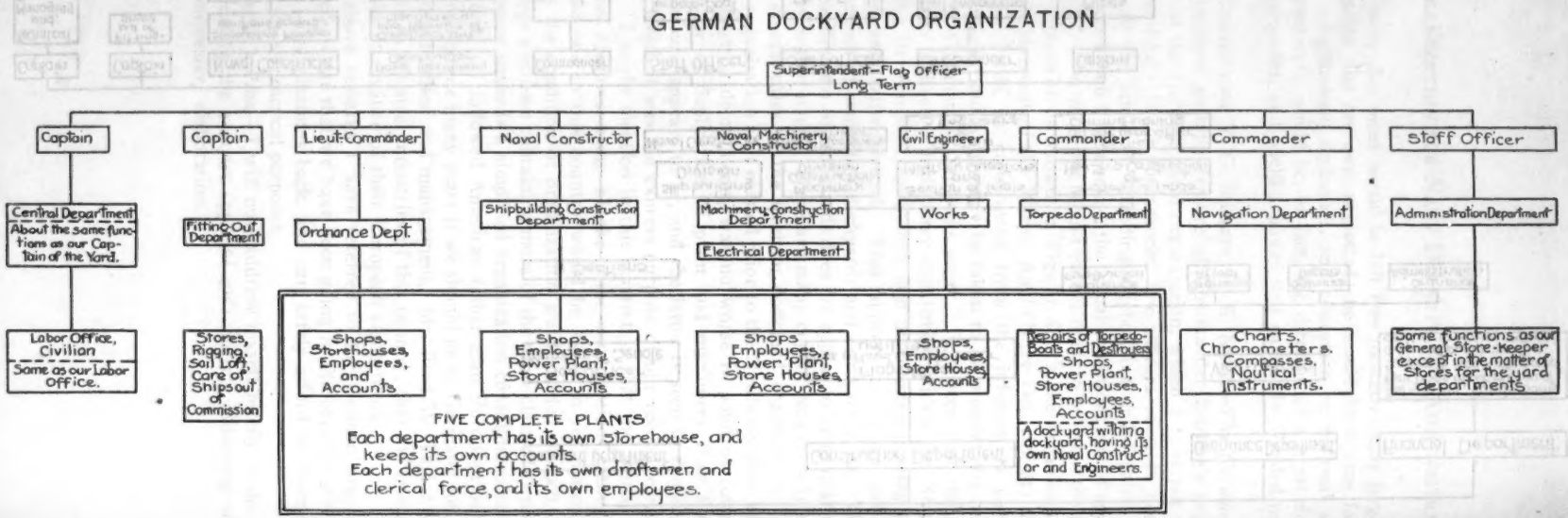

GERMAN DOCKYARD ORGANIZATION
Superintendent—Flag Officer Long Term
Captain
Captain
Lieut:Commander
Naval Constructor
Naval Machinery Constructor
Civil Engineer
Commander
Commander
Staff Officer
Central Department About the same functions as our Captain of the Yard.
Fitting-Out Department
Ordnance Dept.
Shipbuilding Construction Department
Machinery Construction Department
Electrical Department
Works
Torpedo Department
Navigation Department
Administration Department
Labor Office, Civilian
Same as our Labor Office.
Stores, Rigging, Sail Loft, Care of Ships out of Commission
Shops, Storehouses, Employees, and Accounts
Shops, Employees, Power Plant, Store Houses, Accounts
Shops Employees, Power Plant, Store Houses, Accounts
Shops, Employees, Store Houses, Accounts
Repairs of Torpedo-Boats and Destroyes Shops, Power Plant, Store Houses, Employees, Accounts
A dockyard within a dockyard, having its own Naval Constructor and Engineers.
Charts, Chronometers, Compasses, Nautical Instruments.
Same functions as our General Store-Keeper except in the matter of Stores for the yard departments
FIVE COMPLETE PLANTS
Each department has its own Storehouse, and keeps its own accounts.
Each department has its own draftsmen and clerical force, and its own employees.

FIG. 2.

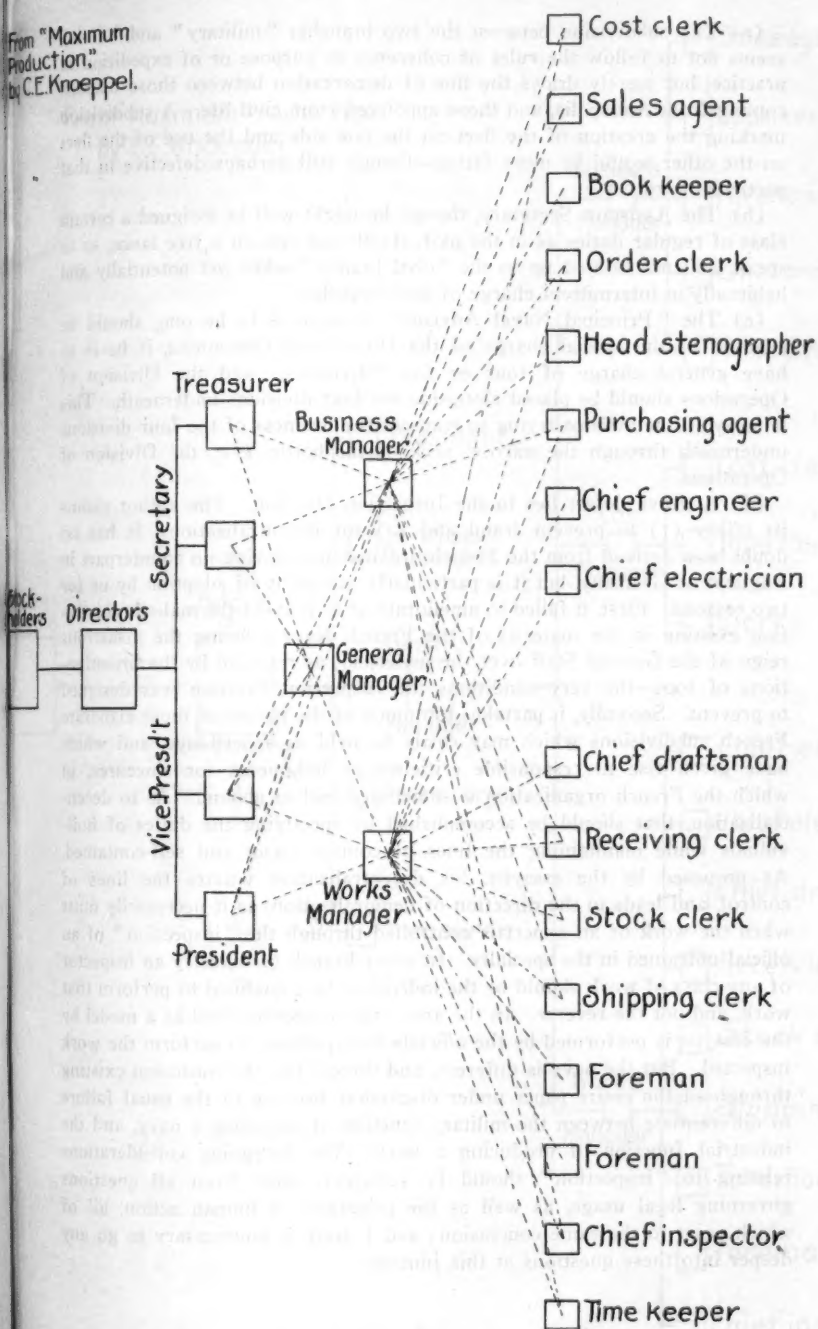


FIG. 3.—An Illustration of Poor Organization.

(a) The subdivision between the two branches "military" and "civil" seems not to follow the rules of coherency in purpose or of expedition in practice, but merely draws the line of demarcation between those officials coming from Annapolis, and those appointed from civil life. A subdivision marking the creation of the fleet on the one side and the use of the fleet on the other would be more fitting—though still perhaps defective in that particular form.

(b) The Assistant Secretary, though he might well be assigned a certain class of regular duties as in the past, should yet remain a free lance, so to speak, and not be tied up to the "civil branch" while yet potentially and habitually in intermittent charge of both branches.

(c) The "Principal Naval Adviser," if there is to be one, should be relieved of the special charge of the Division of Operations, if he is to have general charge of four or five "divisions," and the Division of Operations should be placed alongside the four divisions underneath. This is to avoid the evils of trying to transact the business of the four divisions underneath through the narrow neck of the bottle, *i. e.*, the Division of Operations.

(d) A grave defect lies in the Inspection Division. The author claims its utility (1) to prevent fraud and (2) for decentralization. It has no doubt been derived from the French organization, having no counterpart in England or Germany, but it is particularly unworthy of adoption by us for two reasons. First, it failed to ameliorate or to prevent the mal-administration existing in the matériel of the French Navy (during the disastrous reign of the General Staff over the matériel), as revealed by the investigations of 1909—the very conditions the Inspection Division was designed to prevent. Secondly, it partakes too much of the nature of those elaborate French subdivisions which may easily be held as superfluous, and which have given rise to responsible criticism as lodgments for sinecures, in which the French organization is sometimes said to abound. As to decentralization, that should be accomplished by specifying the duties of individuals while maintaining the lines of control intact and self-contained. As proposed by the essayist, his decentralization vitiates the lines of control, and leads in the direction of demoralization, as it necessarily must when the work of an expert is controlled through the "inspection" of an official untrained in the specialty. In every branch of industry an inspector of any class of work should be the individual best qualified to perform that work, and not the reverse. In the army, the inspection cited as a model by the essayist is performed by the officials best qualified to perform the work inspected. But the navy is different, and therein lies the confusion existing throughout the entire paper under discussion, because of the usual failure to differentiate between the military function of operating a navy, and the industrial function of producing a navy. The foregoing considerations relating to "inspection" should be sufficient, aside from all questions governing legal usage, as well as the principles of human action, all of which point to the same conclusion; and I deem it unnecessary to go any deeper into these questions at this juncture.

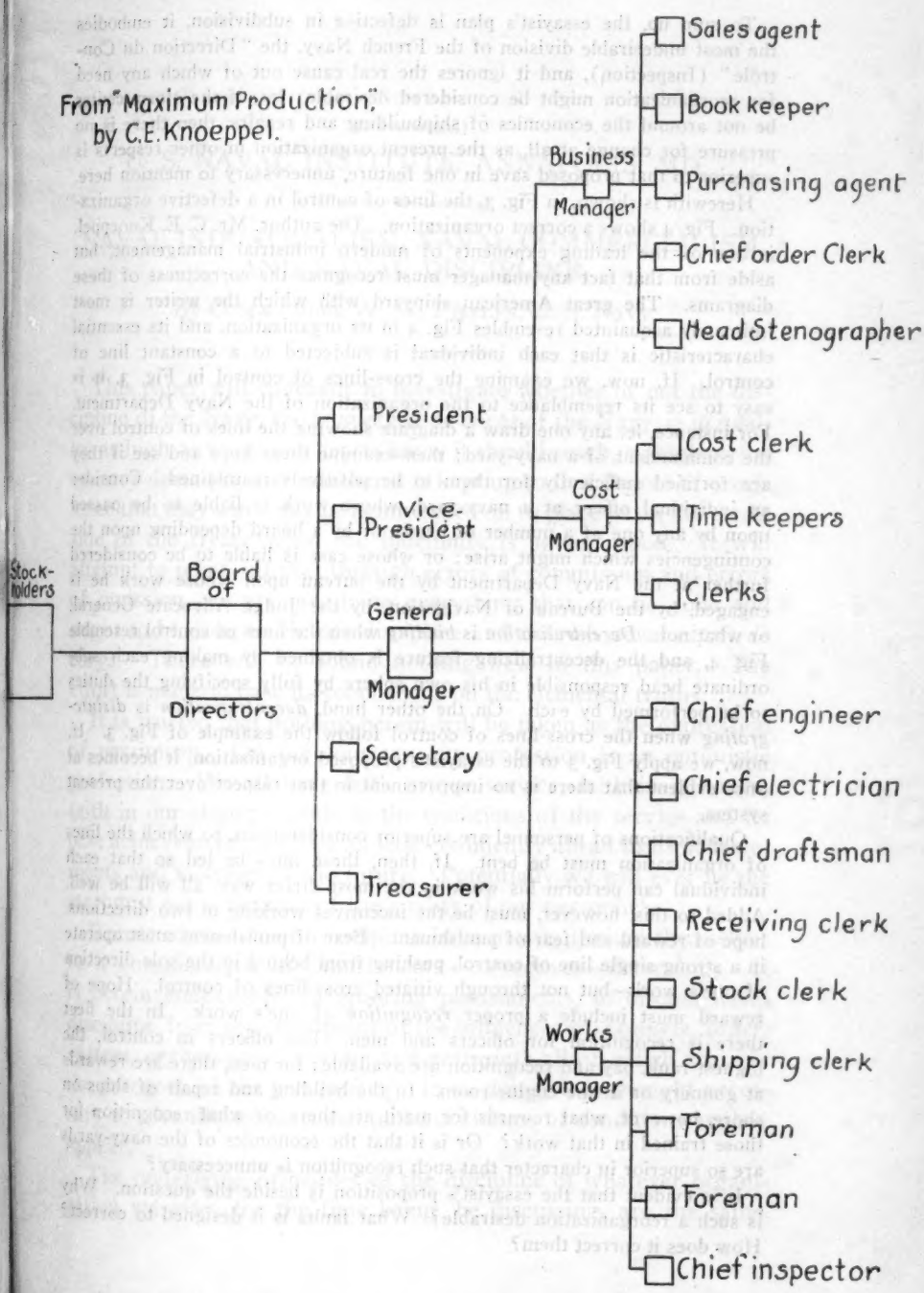


FIG. 4.—Diagram Showing an Orderly and Efficient Organization.

To sum up, the essayist's plan is defective in subdivision, it embodies the most undesirable division of the French Navy, the "Direction du Contrôle" (Inspection), and it ignores the real cause out of which any need for reorganization might be considered desirable; for, if the storm-center be not around the economics of shipbuilding and repairs, then there is no pressure for change at all, as the present organization in other respects is superior to that proposed save in one feature, unnecessary to mention here.

Herewith is shown, in Fig. 3, the lines of control in a defective organization. Fig. 4 shows a correct organization. The author, Mr. C. E. Knoeppel, is one of the leading exponents of modern industrial management, but aside from that fact any manager must recognize the correctness of these diagrams. The great American shipyard with which the writer is most intimately acquainted resembles Fig. 4 in its organization, and its essential characteristic is that each individual is subjected to a constant line of control. If, now, we examine the cross-lines of control in Fig. 3, it is easy to see its resemblance to the organization of the Navy Department. For instance, let any one draw a diagram showing the lines of control over the commandant of a navy-yard; then examine these lines and see if they are fortified sufficiently for them to be positively maintained. Consider an individual officer at a navy-yard, whose work is liable to be passed upon by any one of a number of heads, or by a board depending upon the contingencies which might arise; or whose case is liable to be considered further at the Navy Department by the bureau upon whose work he is engaged, by the Bureau of Navigation, by the Judge Advocate General, or what not. *Decentralization* is *binding* when the lines of control resemble Fig. 4, and the decentralizing feature is obtained by making each subordinate head responsible in his own sphere by fully specifying the duties to be performed by each. On the other hand, *decentralization* is *disintegrating* when the cross-lines of control follow the example of Fig. 3. If, now, we apply Fig. 3 to the essayist's proposed organization, it becomes at once evident that there is no improvement in that respect over the present system.

Qualifications of personnel are superior considerations, to which the lines of organization must be bent. If, then, these lines be led so that each individual can perform his work in the most direct way, all will be well. Added to this, however, must be the incentives working in two directions, hope of reward and fear of punishment. Fear of punishment must operate in a strong single line of control, pushing from behind in the sole direction of one's work—but not through vitiated cross-lines of control. Hope of reward must include a proper *recognition* of one's work. In the fleet there is recognition for officers and men. For officers in control, the highest rank, pay and recognition are available; for men, there are rewards at gunnery or in the engine-room. In the building and repair of ships on shore, however, what rewards for merit are there, or what recognition for those trained in that work? Or is it that the economics of the navy-yards are so superior in character that such recognition is unnecessary?

It is evident that the essayist's proposition is beside the question. Why is such a reorganization desirable? What faults is it designed to correct? How does it correct them?

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL INDUSTRIALISM, NAVAL COMMERCIALISM AND NAVAL DISCIPLINE.

By COMMANDER W. W. PHELPS, U. S. Navy.

This paper will endeavor to investigate whether or not the discipline of the Navy, the true *esprit de corps* of the Navy, is in quality as high as we in our hearts know it should reach, as high as the country demands, and whether it is kept up to that degree of excellence that may some day be again called on to place us on the credit side of the treaty when the indemnity is agreed upon. It will attempt to point out that through errors of commission and errors of omission, we are not doing everything that can be done and ought to be done to elevate discipline and nourish naval *esprit de corps*. There will be found nothing new in this paper. The effort is made to base its conclusions on the elemental truths.

It is trusted that nothing herein will be taken as the expression of pessimism. On the contrary our profession is an optimistic profession. We all have faith in our service, faith in our men, faith in our ships; a pride in the traditions of the service and its past achievements, and we all look confidently ahead to its achievements and victories of the future. Potentially we will ever be the strongest navy, because of the quality of our personnel.

Recent discussions of discipline have mostly limited themselves to a consideration of punishments—correctives—deterrents. It is herein endeavored, in ignoring punishments, to discuss naval discipline from the standpoint of the influences of *example, order, system, organization, routine* and *restraint;* all of which come in the category of *the preventives*. In so doing, it is thought necessary to give illustrations and make criticisms of conditions as they appear.

The underlying principles of the discipline of whatever organization we may, for the time being, be discussing, are the same.

We cannot get away from the fundamentals. In every community, no matter what may be the end of its efforts, discipline is organized living. In society it means to live right because civilization could not otherwise exist. In the family it means to live right for the sake of one's children. In the Navy, it means to live right in order that the human weapon may be made perfect. In the Navy, discipline means to render obligations solemnly undertaken for the spirit of the service. From a material standpoint we receive our pay in order that we may live and that those dependent on us may live. We get our living for our services. That is the material reward. But along with the material reward we should feel that we are receiving a spiritual reward, in the consciousness that we are giving our best efforts to the study of naval discipline, that we are contributing to the spirit of the service.

Discipline has been inherited from the remotest antiquity. It came to Adam in the form of conscience ("And they heard the voice of the Lord God"). It was handed down to the children of Abraham in the teachings of Moses ("And God spake . . . ."); and later it was given living, breathing form in the manhood of the Redeemer ("And he saith unto them, Follow me . . . ."). And all discipline to-day, everywhere, is founded on the example He set to mankind.

The idea of naval discipline that one meets out in civil life seems to be, to the civilian mind, synonymous with hardship, punishment, being made to do things against one's will; and occasionally it will be thought to be synonymous with tyranny. These are not manifestations of discipline; they are the manifestations of the absence of discipline.

The most potent influence for naval discipline is example; "Virtue, honor, patriotism and subordination." The chief responsibility of every officer of the Navy lies in his self discipline; and the more he thinks about and studies the men and their needs, the higher ought to become the quality of the example he will set. Nationally, we are peculiarly fortunate that the opportunities for entering the Naval Academy are as equal to those who can reach the standard as it is possible to make them. It is becoming more and more the custom for the Representative to make his appointments on competitive examinations among the boys of his district, and with this representative material to start on, the course of instruction at the Naval Academy ought to be more spiritual and

less material. Then and there should the start be made to guide the thoughts of the young officer to a consideration of the humanities; that the first thing he may interest himself in and apply himself to on going into the service, is the study of his men, and the bearing of naval discipline towards men. When he leaves the Naval Academy he should know more about the spirit of the service and less about the industrialism of the service. Throughout his schooling he should be taught that his value to the service is going to be greater, the more he recognizes his responsibility in his own humble position to his men. The more deeply he is interested in studying the human nature he will have to work with, the more useful a naval officer he will become. The study of the human element should begin from the first rather than be left to be taken up after the management of the material elements of the Navy are mastered. A captain in the Navy recently said, in observing the midshipmen in white undress ready to embark in the practice ship for the summer cruise, that he could not see much difference between them, in that rig, and the apprentice seamen at a training station. This at once points to the strength of our navy, that in some instances recruits to the training stations and recruits to the Naval Academy appear to come from the same people—all are the product of the century and a quarter influence of republican institutions on our race. So it becomes necessary at the naval school to breed the young officer to there acquire all the finer habits and nicest discriminations—what we expect to find in a cultured man. Let it be borne in mind that the men are from the "ruling class" as well as are the officers. The influence of the officer will depend on the example he sets, and youthful lieutenants on duty at the Naval Academy should bear this in mind; for the midshipman regards the lieutenant he sees there daily as the type of the service. There is no reason why an occasional midshipman, when just graduated he joins his ship, should appear to think that his importance to the men is indicated by the extent of his profanity.

And at the training stations, and subsequently on ship board, everything in the routine and surroundings should appeal to the best side of the recruit. Now naval discipline, proper discipline, appeals only to a man's better nature. Punishment appeals to his worst nature. A well disciplined man requires no punishment, because his better nature has been appealed to and his conduct

responds to that appeal. Punishment comes to be inflicted because the man's worst nature has for the moment dominated his conduct, and therefore punishment appeals to the worst side of the man. Improve naval discipline, improve all that appeals to a man's better nature, and the causes for which we inflict punishment will diminish. Character is the foundation on which we build a well disciplined man, and every uplift, no matter how small, supports and fertilizes the growth of character, whereby the better nature of the man is strengthened, from which we get fewer outbursts of the worst nature.

In arguing that the undergraduate course at the Naval Academy should more thoroughly expound the naval classics and analyze more thoroughly the dominating qualities of the great seamen, in order that those sympathies and instincts and niceties of discrimination that must mark the officer and *gentle*man may be best nourished and best bred, one has in mind to inculcate early in the youngster that habit of realizing how important to the men must be his bearing from the first day he reports for duty. And an understanding of the qualities of heart and mind that have exemplified the masters of our profession will make his service afloat happier, by engendering in him a pleasure in getting the best out of his routine work, which must be the compensation to the naval officer at sea for his personal sacrifices. And in looking to see how this study of the naval classics can be included one reflects that four years at the school is a short space considering the forty years of activity. And in that short space of adolescence the foundation for future usefulness to the service is built rather on character than on the management of the material things of the Navy. Not merely a character of the average and usual good qualities, but, more than that and in addition thereto, qualities of character that will be called on immediately on graduation in commanding men. In that short four years there are three very short practice cruises. Each cruise is three months, three short months, in a year. All told the practice cruises consume nine months. Nine months is a short space in which to cultivate the ancient sea habit, something indefinable, yet something that we recognize among ourselves as a peculiar quality of the professional mariner. So the questions arise: Is it the best sort of a practice cruise to continue delving into materialistics, when time might be spent in getting the young man in sympathy with the best products of the

mariner's profession? For young men who study hard eight months, should not their summers be free from note books and sketches and academy brain-work in ill-ventilated ships' compartments? Could not lasting and valuable lessons in naval history and in the spirit of the service better be learned? Mentally and physically would it not be better? Are there not already too many young officers prematurely gray and bald and wearing glasses? Can incessant brain work eleven months a year be the best undergraduate education we can give? Should they be sent for the three months relaxation from brain-work to duties from which those who are regularly performing them require periodical relaxation themselves? Should they not better be held apart so as to be led throughout their undergraduate life to idealize the service, by being spared, as far as may be possible, contact with any of the seamy side until they would be less susceptible? In some respects the old sailing ship was an ideal practice ship, even as lately as the early days of battleships and destroyers. Its simplicity brought about a quicker touch with the sea, owing to the absence of machinery and the saving for other activities time which would otherwise be occupied in that management. With sail shortened for over night the youngsters would get a real night's sleep mostly in the open air. It was the convenient toy in which the young officer could learn how to command. In a consciously conspicuous (commanding) position on the horse block from where his voice would carry throughout the deck, knowing that he was being given critical attention by the men, he had, at every stage of working ship, a visible and direct application of his commands, through the men, resulting in the behavior of the ship. And if the ship worked badly it was directly impressed upon him that it was his fault, his imperfections or his inexperience; whether by poor command the men did not move properly, or whether by poor judgment the ship failed in the evolution. To-day we get a parallel situation; only, interposed between the command and the result, are many men, many decks, many complicated devices. But the quality of the result to-day depends, as before, on the quality of the command. Nobody remembers how many reef points there were in a topsail, or the order of the rigging over the foremast head. A lasting familiarity with the sails, spars and rigging would be inconsequential; but the sailing ship to-day might be made a vehicle for the culture of the naval officer, a classic of his pro-

fession from which value is derived, just as the dead languages remain a vehicle through which a shore university imparts culture to a scholar. These reflections are applicable to emphasize that, in the service, we must ever keep mind above matter; and, it is thought, they might also serve to illustrate that the best principles that should underlie the new navy can be derived from those things that were best in the old navy.

In our material achievements, the Navy is making notable progress. But, is the *spiritual* side of the Navy being at the same time elevated in harmony? We build a battery of 14-inch guns for a ship. When these units are in course of building, every step in the construction follows the physical and scientific laws known to the designers; and when the battery is mounted we have this element of the ship's power, each unit identical with every other unit, a finished, a finite product. The ordnance officer will tell us exactly what are the limitations of its use, what it can do and what it cannot do. So it is with each material element that goes into a ship of the Navy. But when we come to construct the crew of the ship, there are no laws of science that can be applied to make each unit of that crew like every other unit of the crew, to make each unit of that crew go to a definite elastic limit with certainty. We are dealing with the human element, and must build our structure on the fundamental truths of the discipline of life, guided by principles which have come down to us from the seamen who have given us our naval laws and regulations.

In dealing with the material elements of the fleet, there are definite comparisons that can be made of ship against ship. We can tell with certainty that in gun power, armor protection, endurance, such and such a ship is superior to some other ship. But in considering the human element our standard must be our imagination, our ideal. Any comparison is indefinite. And if we constantly study what it is necessary for us as officers to do to carry us along the straight and narrow road toward that ideal, we can at least feel that as far as human experience goes we have neglected nothing in the effort to perfect the human weapon.

We read much in the papers about the ships, and the editors measure our power on the sea by the number of ships we have. Now it is not the first care of the naval officer to worry about how many ships we should have. That is a question which properly rests with the statesman. But it is the care of the naval officer

as to what shall be the qualities of that ship and his first care must be the human element, the most vital quality.

Of all the departments of the country its armed forces, the Army, the Navy, and the Marine Corps stand conspicuously in a class by themselves, distinctly aloof from the civil departments. The failures and inefficiencies that may be discovered in a civil department will not necessarily have a lasting effect on the prestige or the future of the country. But we can only surmise with respect to the armed forces of the country how far failures and inefficiency would affect the future of the whole country, the future of the race. So we are justified, considering the Navy, in inquiring wherein we can raise the spirit of the service. It is nothing less than the spirit of the service that we should constantly seek to drive out any weakness, big or little, that we can satisfy ourselves is standing in the way of the development of the human weapon. It is not sufficient for us to rest on over confidence and let well enough alone in respect to the human element when there is no possible way to definitely compare its degree of excellence. We are proud of our gunnery, but in spite of the flattering mention of it by the newspapers we know it can be improved, and we know it can only be improved by the development of the ordnance going along hand in hand and harmoniously with the development of the human element. We are proud of our engineering, but we know that it can be improved. We know that progress is being made in the development of machinery and no man can say yet where it will end, but we know also that economy in the use and management of that machinery can be further achieved by the development and organization and the skillful handling of the human element. So it is not in a spirit of fault-finding that these thoughts arise. Rather it is a tribute to the high quality of the men of the Navy that we should inquire wherein, if such can be admitted, we can lift moral oppressions so that character can develop the better; and by developing a better character, we acquire a more intelligent, more earnest and more self-reliant human unit.

It is not easy to say that we are yet a race of people. Some families in our country have been influenced by the institutions of the country for some generations. There are some young citizens in the country whose families have not been long enough in the country to have become amalgamated. These families are undoubtedly devoted to our institutions, but it is a question whether

their devotion can yet be quite the same as that of the citizens of the older families, to whose families the national sufferings and sacrifices of the past are a part of family history. The families who are not yet amalgamated may later trace their devotion to the opportunities they have found under our institutions for their material uplift, and to the greater opportunities in this country for their children. Many of the young men of these not yet amalgamated families present excellent qualities, indicating fine characters, and they are capable, under our institutions, of a greater degree of culture than they or their progeny could ever reach in the old country under the old world system. We probably have many such young men in the Navy, probably a number of such enter the Naval Academy. Now these men to become disciplined must have instilled into them a spirit of the service from their entry. By a spirit of the service is meant some understanding of naval manners and customs; a respect for, and confidence in seniors all the way up the line; and an understanding that every duty on board ship is entitled to its proper respect and attention, and that without that duty being done some cog in the great machine would slip; a reliance that whatever they are called upon to do, it is something that is necessary to be done; a reliance that every condition imposed on them is the best condition that human experience can so far devise. So that, when they pass on to be petty officers, they will then begin to see and to hand down to newer recruits the why and wherefore, and the manners and customs and laws and regulations. We have a navy of voluntary enrollment, and while in civil life we are on an equality and the behavior of one man may not affect the other man in the same community, in the Navy we are in an established relationship where the example of the senior is all-powerful. Every one of us has his responsibility in that respect in due proportion to his rank, and when that example is not the best example we are capable of, then we are not doing all that can be done to influence the juniors. Unlike the old world navies, where aristocracy keeps people in classes forever, our navy has its greatest potential strength in the fact that, to a great extent, it is bound to reflect our democracy, and therefore our men must be led, not driven.

We read much in these times about too much materialism in life; about ordinary aspirations being commercialized; and it is barely possible that the Navy too is suffering from these influences. We

read that this results in the material oppression of the masses of the people, and if this be so must it not also mean the spiritual oppression of the people—depreciation of character? At this writing a political campaign is on. For the first time in many years the necessities and the rights of the people at large appear to have thrust themselves to the front as national issues. The humanities are enlisting the championship of men and women from one end of the country to the other. These champions claim that the people at large have been stunted and dwarfed in moral and material growth by the manner in which civil industrialism and civil commercialism have been applied throughout the country. If we are to believe what we are told by the papers and the literature of the day discipline, *esprit de corps,* is being displaced in governmental and municipal organizations in civil life by commercialism. Some men whose position and influence and responsibilities, both private and public, should engender the finest sort of self-discipline, are, by their examples corrupting and depreciating the character of the communities or organizations through which their influences permeate. What is the outcome? There are young men in the land coming into manhood bred to regard as the object and end of life in the United States the getting of something for nothing. No matter what the means, the end of getting something for nothing will justify the means. And only to get on a government or municipal pay-roll in civil life seems to be regarded as merely securely intrenching oneself in order to commercialize the laws which were enacted with the belief that they would uphold the discipline of the community. The tendency of these influences is to degrade the character of the race, and to breed in young men a quality of unconscious indiscipline, a spirit of commercialism and selfishness. Some of these young men may enter the Navy. Some of these young man-o'-warsmen at the outset may base their allegiance to their ship too much on her being a "good feeder," or on how much liberty she gives, or how often she has moving picture shows. And is it not possible that there might be in our present system a lack of the spirit that should correct the commercial standpoint? Possibly some of the young men we recruit into the Navy have grown up in communities wherein, more or less, have prevailed the commercialized ideas of government or municipal employment. It is so of the boys who go to the Naval Academy as well as of the youngsters we recruit

into the Navy. And in trying to study the problem of naval discipline and the molding of the human element into the perfect human weapon, it might be well to reflect as to the character of our particular brand of human nature; to reflect whether there have been previous environments which will be to us a help or a hindrance; to inquire into our own manner of handling men to find out whether the discipline we are called upon to construct is really discipline or only tyranny, for when we permit officers to do things which, in the men, we would penalize, we allow tyranny to replace naval discipline; to inquire whether in our system we are maintaining that official classification, which though not developed in civil life, must prevail in the Navy in order that there may be *esprit de corps;* to inquire whether our methods instil into the young man-o'-warsman that profound respect for his duties which we must endeavor to instil into the humblest and least important of a ship-of-war's activities in order that *esprit de corps* may have a fertile soil in which to flourish; to inquire whether there may be any event in ship-board life that may suffer indignity by being commercialized; and to inquire whether there is anything in our system fundamentally opposed to breeding discipline, whereby being opposed to discipline it must oppress discipline and depreciate character.

How has naval industrialism come to predominate? The expansion of the navy material out of proportion to and out of harmony with the expansion of the navy personnel has caused it to dominate. The gunnery awakening in 1902 was born and bred with a personnel then not sufficiently disciplined to withstand the shock of endeavoring to excel in gunnery at the expense of organization and realism. For it is believed that the same progress in naval gunnery could have been achieved had we held on to organization and routine throughout. It would appear that "scientific management" *is* organization. Naval gunnery is scientific management—shore experts have so called it. There can be no scientific management without organization, and routine is a part of organization.

It is easier to look back than to look ahead. We admire with gratitude the zeal and genius that awakened our gunnery and fired the whole service; but it would appear that it was a pity that the older heads of those days did not recognize that, some day,

we would see the disappearance of those naval standards we then had in sweeping aside organization and routine to bring guns, mounts, sights, and (they thought) men up to the new standards.

We see to-day the crews of our ships of war merely an aggregation of well ordered citizens. When we have "quarters," those who have "no work to do" go to quarters and line up as at a mass meeting on shore. All others who "have work to do" put on dungarees and stay away from "quarters." The industrial chieftains on board ship—the heads of departments—themselves bred up in the midst of modern naval industrialism, will tell us that they can't get so-and-so ready if their men have to come to "quarters." The men readily enter into that spirit, and they are also sure so-and-so can't be ready unless they are excused from "quarters."

Now it may be justly agreed that we have, in our turrets, manifestations of a high degree of discipline. But have we always *naval* discipline? There are countless exhibitions of discipline in industry on shore. To get our excellence in turret shooting is only team work, a trained-to-the-minute team just as is a foot ball team, a no more highly trained group of men than, for example, is the team that will get out, day after day, year in and year out, a great newspaper by the hundreds of thousands, and have those papers delivered through the mails to arrive out of town the same morning. We must have something more than discipline, we must have *naval* discipline, and that not only means an excellence in the turret for the time being, but an excellence in every other activity small and great that must be met in the day's work on ship-board by every man of that turret division. And if we are to have a military navy, one of the requirements must be a week-day military assembly of all the men it is possible to muster, with a standard ceremony that has a *military* influence. "Quarters" from time immemorial has been, we might say, the daily bench-mark of the activities of the ship's near a thousand men. It is the daily tautening up that every fighting organization must have, and it will be found that men, under the military influences, in the long run, become so habituated that all their standards improve, even to the extent of their industrial output. If this is not so, then there is no truth in the belief that ex-man-o'-warsmen readily get good positions when paid off.

Some other manifestations of the dominance of naval industrial-

ism might be said to be: The socializing of ratings by emphasizing the industrial qualifications before the naval qualifications. A lack of excellence in some of our drills and exercises because the ship does not always go through them as a unit; for who has not heard the blacksmith's anvil singing merrily during "general quarters"? The more "general" a concentrated drill is required to be, the better the results, and the shorter will become the time required to gain excellence.

The vagaries and varieties in the wearing of the naval uniform manifest the ascendency of naval industrialism over naval discipline. Look closely and one will here and there see firemen second class and ordinary seamen and coalpassers, masquerading in three cuff stripes instead of two; officers' stewards and officers' cooks in caps with the c. p. o. buttons and chinstraps; mess attendants revelling in three cuff stripes because they are "first class"; officers' stewards and officers' cooks sporting the long overcoat assigned only to the c. p. o. ratings.

In the anxiety to excell in the material things, one can find occasionally an officer who regards the little things as beneath him, and this officer will be apt to view with disdain another who sees in the perfection of the little details concerning the men the foundation of efficiency in the bigger things. There should be a time and place for everything. It *should* be the duty and care of the juniors to enforce the little details like uniform observances using the organization of rating and command to gain the results; but these results are difficult to gain when many ratings do not mean authority to command, and when our present system does not afford us sufficiently a manual for commanding men on ship board, such as we formerly had in *Luce*, wherein each activity on ship-board was governed by a tactics as standard and as explicit as the manual of arms.

The officer of more experience regards the little matters as manifesting the general standard of things. We look on the surface of the sea to find out, from the ripple, from where blows the wind. So we can judge, by the little things everywhere in life, what standard would result, whether high or low, in the bigger things of which the little things are small elements. We take pride as to the external appearance of our ship, and are properly concerned that she presents a neat and trim appearance. She may be faultless in other respects, but if her booms are not square the impression is not pleasing.

Now we are all delighted whenever a law is passed prohibiting discrimination against the naval uniform. But what do we do to make the ratings themselves respect their own stripes and badges? We do not appear to seek out and prevent men entitled to only one cuff stripe or two cuff stripes sporting about in three cuff stripes. What respect can the men who are entitled to wear three stripes have for their own rate marks? And what respect can the youngsters have for the rating that wears three cuff stripes? Do we not belittle the chief petty officer's uniform—and thus the chief petty officers—by permitting officers' cooks and stewards to wear a chief petty officer's overcoat, when a pea jacket for officers' cooks and stewards is distinctly prescribed?

Charity begins at home and so does respect for the naval uniform. And the first step in breeding respect for the naval uniform is to prevent men from putting on stripes and other badges that they do not rate. The above irregularities are widespread, and indicate two things; one, the complications we suffer from too often changing an already complex uniform, and the other, an apparent feeling among some of the men that their uniform doesn't mean to them what it should. It's hard to get an industrial organization to wear a uniform. It's easy to *uniform* a military organization.

Dungarees (a tender subject!) *can* be kept within the bounds of a normal naval industrialism. Compare the brief and clear limitation to the wearing of dungarees found in the Navy Uniform Regulations of 1905 with the abuse of the uniform today. The dungaree habit expresses overworked naval industrialism. Ask the officer who believes in the unlimited wearing of dungarees what is the reason for them, and he will be apt to say "dirt," or "they don't *show* the dirt." The result is that on board of our ships one will frequently hear such expressions as "dirty work," "dirty working clothes." The effect of this on many a modern young man-o'-warsman is this: He keeps a fairly clean suit of clothes for "quarters"; before quarters and after quarters he wants to get into a rig, which he rarely scrubs, which is *soiled* beyond all conscience with the natural accumulations of constant wear. Now we should not speak of the naval labor our men must accomplish as "dirty" work. It costs nothing to dignify all of it by simply referring to it as "work."

There are things in this world which may be wrongly and

thoughtlessly designated until people sooner or later come to believe that they are just what the incorrect designation makes them. There is not to be found to-day, as there has never been heretofore, except possibly that required of the yeomen, any labor on board of a man-of-war that did not require some personal cleaning up after. It is impossible to prove that any other color or fabric would take in more "dirt" than dungarees. Whether a man wore green, red, pink, white or blue colored goods, a job of work would affect each like any other. The tendency is everywhere to run to white as a color in order to discover "dirt." We would rather deal with the butcher or the grocer who is rigged in a white uniform and a white apron. At the end of the day those uniforms might be marked with the evidences of an honest day's labor. But they go to the wash. The next day he is as fresh looking as the morning before, and we are content. But if he wore the same smeared uniform to nearly the end of time he would have to go out of business. Now it would seem that where upward of a thousand men have to live in a ship; from the standpoint of personal cleanliness, the clothing that that organization of men is to wear should not be such as to cover up the reasons why that clothing should be scrubbed, but rather that the clothing should be such that the necessity for scrubbing it should appeal to the man himself. In one of the European navies their man-o'-warsmen, whatever may be their stations and duties in the ship, all wear an identical unbleached fabric, cheap enough to be frequently replaced, strong enough to be frequently scrubbed, and frequently scrubbed enough to be healthful, both morally and physically.

The trouble seems to be in the Navy that the dungaree habit has lulled us into the incapacity to distinguish between the honest stains of honest naval labor, which nobody can object to, and the natural accumulations due to the constant wearing of an unscrubbed uniform.

One of the results of the dungaree habit is that the crews of most of our navy yard tugs up and down the coast, and some of the tenders of the Atlantic fleet look more like pirates than man-o'-warsmen on auxiliary service.

Another result is the struggle the executive officer must have to keep even officers wearing dungarees out of the mess room and off the mess room furniture.

This much ought to be said, that in our ships of war, the men who have the greatest claim on dungarees, the machinery department men, are in addition to being personally the cleanest body of men in the ship's company, the men who least abuse the dungarees, and who scrub them the oftenest. Outside of the engineer force, at least it would seem, there can be no justifiable reason for dungarees.

Old-fashioned naval standards are disappearing, and can we altogether say that really good standards are taking their place? There is hardly a single activity on board ship but must require patient promulgation of explanatory notes to get it done after a man-o'-war fashion and in accordance with the naval regulations and custom.

Contrast: In a British all-big-gun ship, her executive officer said he did not have much printing done because he had to pay for it himself, so it was understood. He exhibited the ship's daily routine, for which he himself had paid to have printed. It was a large placard of bristol board. The events of the routine, done in quite large, heavy type, were readable a number of feet. They were done in simple man-of-war language, comprehensible to the humblest. Many words were abbreviated to the initial letter. The whole thing gave evidence that in their material expansion, the leading strides they have taken in construction, engineering, and gunnery have not been allowed to diminish the understanding of naval manners and customs as necessary in carrying out the daily routine. This was the impressive thing about a routine placard so abbreviated as to merely convey a hint to all hands, from the watch officer all the way down, yet unintelligible to the English speaking naval officer from the other side, whose own navy is generally thought to have inherited man-of-war manners from the British.

In our navy every one is kept so busy with paper work that it is well nigh a physical impossibility to enforce a standard among the ships as to uniform about decks, external appearances and routine. Contrast with a British squadron which came to anchor in Annapolis roadstead seven years ago, and all five of them laid aloft and laid out together to paint spars. And as to paper work. The executive of a British five turret ship was once asked where was his office? Who looked out for his paper work? The answer was understood to be that he had no office, no paper work

to look out for to that extent, and that the captain's office took care of all paper work anyhow. Contrast with the activity in an office of one of our executives.

It would seem that we have not been able to be so fortunate as to expand harmoniously, and carry along with us at the same time many of the good old standards and the good old simplicities. We look at Navy Regulations of 1909, amended by changes one to nineteen, and sigh as we recollect the simple "Blue Book," edition of 1876.

It cannot be denied, if the salute from the junior to the senior manifests respect for rank, that naval officers are not held in the esteem by their juniors that should be exemplified. Playing officers and men on the same foot ball team has had a very socializing effect. This has commercialized the officers for the sake of the men's athletics. Happily this has been stopped, and we will outgrow the harm, to some extent. A few officers are looked upon by some of the men possibly as foremen; for this those officers are themselves to blame for a lack of the personal qualities that should distinguish them as officers.

One may pass artillerymen or marines on the streets of Fort Monroe and one will receive the salute due one's uniform done in a way that stamps those corps as disciplined corps; full of *esprit de corps*. One will pass squads of men from one's own or some sister ship and one will be merely gazed at with innocent curiosity or else ignored, or else occasionally saluted. All the while we are being admonished to require our men to render the immemorial salute due from the junior to the senior, and yet our system is such as to break down any such manifestation of *esprit de corps*, because it is founded on naval industrialism and not on the fundamentals that make naval discipline.

A machinist, under the law, may pass up to an ensign. Yet in the Regulations we find ourselves prohibited from giving a machinist any sort of deck duty. This is a flagrant expression of industrialism.

Strangely enough, while we have progressed in the amalgamation of all combatant officers, which is absolutely and fundamentally correct, we are year after year extending the industrial spirit among the men by specializing ratings more and more. The regulations and customs limit any sort of command authority to the men of the seaman branch. This is an expression of indus-

trialism. Many of the *titles* might be swept away. All *seaman* branch men should be designated chief petty officer, petty officer 1st class, petty officer 2d class, petty officer 3d class, and the rating, "master-at-arms," should be abolished—as has lately been done in the British service according to reports abolishing "ship's corporals." Eventually electricians should be merged into machinist's mates. We make trouble for ourselves in organization by adding to the complexity year after year, rather than by trying to simplify the situation. And this increasing complexity is one of the reasons why our ships seem to need more men than the British ships. The British five turret ships are run on something like a hundred men and marines less than our five turret ships require.

One occasional example of somewhat overworked naval industrialism is found in a battleship going through her overhaul and obliged to work the men at unskilled laborers' jobs day in and day out, in obedience to the "work to be done by ship's force" order. There is already sufficient necessary "work," "labor," to require of the men in all conditions of cruising. It is reflected that there are three kinds of work on board ship at a navy yard; that necessary in the ordinary usual running of the ship and upkeep; special work on the fighting elements—the machinery and the battery; and extensive "laborers' jobs" in conjunction with some yard department work. The first is necessary, and it is a part of the life. The second is on the fighting elements that the men love to work with because they are their weapons, and therefore there is a pride in working over them. But the third is without glamor and without compensation. The third tends to reduce the young man-o'-warsman in naval manners, bearing, uniform, and aspirations to the level of the navy yard unskilled laborer. Now it does not appear that we enlist men for "laborers." We enlist men for man-o'-warsmen. And when a youngster enlists in the Navy, it is possible that the main vision he has is of becoming a skilled naval artisan or a gunpointer or a seaman petty officer or an engine department petty officer. The morale of these youngsters and consequently their usefulness, it would appear, would be better preserved were they kept in hand, and could certain common laborers' jobs be turned over again to the yard laborers. Formerly this was so. This class of common laborers' jobs would not appear to have any bearing on the propo-

sition that the fleet must be bred to be self-sustaining. (Specific exemption should be made to the cleaning and painting of ships' bottoms when docking, true naval labor as much as is coaling.)

The ships that sustained themselves five years ago in a fourteen months cruise around the world proved that they were self-sustaining. And this was demonstrated before the "work to be done by ship's force" principle came to dominate. There never has been any trouble in making repairs to the limit of the capacity of ship's tools and workshop. The men have had the ability. Officers who know have said that up to the limit of these workshop resources they would *rather* effect repairs with our own men than with navy yard men.

Therefore it is believed that an organization that seeks to be military, that is training for the grandest game in the world, and which in the nature of things imposes many disagreeable humdrum tasks on its men, should best keep training the lowest ratings along the lines that are peculiar to the man-o'-warsman, and not sacrifice opportunities of value to work at unskilled labor. It can be questioned whether it is altogether wise to attempt to save money at the expense of the young man-o'-warsman's morale. Our commanders-in-chief have recognized this situation, for we have been admonished against this possible depreciation of morale.

We insist that it is necessary that the sea officer should command a navy yard, that it is a sea officer's command. That is true. But—on the door of the commandant's office there did not appear even the title of the rank of the officer. The officer's name was painted just as though he were a real industrial chieftain and not "Rear-Admiral" ——. This may be said to be an expression of a dominating naval industrialism. We insist that the naval command of the navy yard is paramount, and yet we drop the naval designation and the naval title which, in another breath, we insist is the only designation which carries naval command.

Inconsistencies are bound to arise in an over-industrialized fighting force.

Out of sight may well become out of mind. Naval industrialism should not be allowed to drive our naval designations and naval titles out of sight. For to each of us, his naval title is his hall-mark in life, and after—will be his epitaph.

In our anxiety to amuse and entertain the youngsters we will run a moving picture show on into the first watch when it should

have been shut off in time to turn the men in at routine taps; and this happens time and again. Now this seems a small matter, but what is the real effect of this setting aside of just one event of the routine? It is just as essential a part of our organization that the men should be turned in and silence kept at nine o'clock as that they must turn out at five; imperative if we turn them out at five, otherwise we are allowing or making them burn the candle at both ends.

And as to the moving picture shows and ship-board entertainments generally, it is to be observed that in the nature of the case officers and men sometimes find themselves unduly crowded together at these shows. Sometimes it is bad, sometimes it is not so bad, but to a more or less extent it is always so. This cannot help but be adverse to naval discipline.

The whole proposition of evening entertainments extending beyond tattoo *on board ship* is open to question. Those more ambitious shows might better be given in the afternoon. Moving picture shows should invariably end in time to get time-honored quiet and the men turned in at taps. Evening shows do no good. They may serve a bad purpose, on the contrary. They offer opportunities for undue liquor drinking to some of the younger officers, with sometimes the demoralizing spectacle of one or two affected young officers on board ship in sight of the men. And then there might follow something that is tyranny rather than naval discipline (it has occurred), namely; after the show one of the men may be apprehended under the influence of liquor. He is court-martialed.

Such an occurrence as this cannot elevate that confidence in naval discipline with which we must inspire our intelligent new navy man-o'-warsmen.

There is really a difference between our obligations when we are on ship-board, and what we may do when on shore.

Nothing has been instituted in the Navy so well calculated to help the spirit of our men and ameliorate the irksome periods of man-of-war life as amusements and athletics; but in handling the amusements of the men, it is repeating what has appeared in the pages of this publication before, to say that we do not have to "cater" to the men to make them contented. We have many youngsters who have not been long enough in the Navy to know much of the necessities of naval discipline. To cater to them will

not bring contentment or naval discipline, it will only arouse in them a socialistic view of a naval system so weak. All the men's amusements should be so ordered as to in no way conflict with routine. How few men obey the call to "hammocks" now-a-days. Are the men to decide for themselves whether they shall or shall not obey a bugle? Yet this is practically what happens during a moving picture show when conflict with the routine allows the call to "hammocks" to sound during the show. Such a small thing as this cannot help but breed a deficient regard for many other bugle calls.

These things illustrate the important interdependence of routine and naval discipline, and how we must guard against commercializing naval discipline in amusing the men.

There are certain sanctums that must be maintained on board a man-of-war. The quarterdeck, the cabin, the ward-room, the junior officers' quarters, the c. p. o. quarters and the crew's deck space and living space. Each is consecrated as the residence of the appropriate authority. Officially they are established reservations. Where official lines are drawn and may not be officially broken, they may be broken unofficially only with the utmost discretion lest harm is done hard to repair. The harm to naval discipline by unofficially violating official limits is inversely in proportion to maturity and experience. The "captain and officers" can and must, to at times conform their official obligations to the social amenities, be hosts on board at an evening reception, during which the official barriers suffer no shock in being for the time removed while the quarterdeck is enjoyed indiscriminately. But should the men, with their immaturity of years and immaturity of character; their inexperience and their present-day somewhat uncertain understanding of naval discipline be conceded the privilege of holding a ball on board ship in the expectation of adding to their contentment, the event necessarily, to some extent, unofficially departs from their official limitations, and once their official limitations are thus tacitly admitted to be easily waived, successive occasions are apt to arise where wider latitude is sought. Restraints come to be difficult to exercise. Vexatious situations arise incompatible with a man-of-war, and a socialistic feeling toward necessary restraints and limitations will result, and this will breed discontent. All will be due to the very concession that was thought to make for contentment.

A general tautening up on board the ships would seem to be advisable in order that the men can have instilled into them the understanding that a battleship is first of all a man-of-war; and it would seem best for naval discipline that the men's social affairs should be held on shore. It might be applicable to observe that there can be some things on board ship which, if we "first endure," we finally are forced against our will "to embrace."

The transition from privilege to license may become undefined. What can we say of a battleship wherein the crew, very largely of youths who know nothing of the relation of the present-day navy to the navy of the past or to the navy of the future, are licensed to "take charge" on New Year's eve; a howling, riotous mob, setting off the general alarm, blowing on bugles every call in the category, parading throughout the ship, even to invading the officers' quarters, destroying thus the dignity of what should be a well-ordered, powerful fighting unit? Can it be possible that this adds to "contentment?" Is this an expression of naval discipline?

Or what shall we say of a system wherein the men, under cover of mask and wig in a ship's minstrel show, will ridicule some personal peculiarity of an officer? Is there not something wrong whereby the very suggestion requires us to exercise prevention to the end that it does not occur? Is this an expression of naval discipline?

Patriotism is *a* religion. A religion is taught by the example of its preachers and professors. The spirit which supports and animates the professors of a religion is given added strength by the vestments and ritual which hand on through generations the glories and beauties of the faith of the past, and which symbolize the virtues and the sacrifices of its saints and heroes.

To the Navy the uniform is its vestment and ceremony its ritual. The life of a fighting organization depends somewhat on its ceremonials. The order, some time ago, which transferred the Sunday *dress* inspection to Saturday was not enough, explicitly to *require* that the same uniforms and ceremonies with which we used to inspect the crew and ship on Sunday, should be conformed to on Saturday. Hence there has come to be a general abandonment of *uniform* on Saturday inspections. The result is that, to the men, a captain's inspection generally means nothing. Instead of that *feeling* that when the captain inspects "I must put on my best,"

one can pass the word "uniform blue dress" on a Saturday now-a-days, till one is blue in the face, and many of the chief petty officers and men will assemble in second-best. What else can we expect when the captain inspects in "service" uniform? The influence of this one thing, in harmony with industrial and commercial expediency, is already manifest. We are occasionally receiving admonitions about quarter-deck ceremonials, and yet we have surrendered to an industrial system belittling the very ceremonials that breed the manners and customs which, in the old navy, held us up to standards that never required admonitions to get us up to and keep us there.

The present deck court law might be said to be an expression of naval commercialism and naval expediency at the sacrifice of good principle, in this way:

It appears that a demand arose for a simplification of the summary court method. On looking around, a parallel was apparently thought to be found in the army summary court, and the deck court was devised in consequence but from an entirely erroneous point of view. For the administration of discipline in the Army differs somewhat from the administration of discipline in the Navy.

It is understood that petty punishments in the Army are inflicted by the company commander. The summary court, it is understood, is constituted in a field officer; so that, in the Army, the passing *up* of disciplinary action is sound. But in the Navy we have devised a law whereby the captain of the ship is limited to infliction of petty punishments, and disciplinary action in the hands of *one* officer is passed *down*. That is to say the law now confides in a junior on board ship, punishment which it refuses to vest in the captain of the ship. The captain ought to be the deck court officer. Any such method as we are now following is apt to have its subtle influence for harm, is inconsistent with the proposition that increasing responsibilities would rest on increased rank, and is bound to be opposed to naval discipline.

An example of naval expediency which disregards naval principles is found in disorganizing a battleship during two or three months of repairs and commissioning temporarily another battleship. As a material achievement it demonstrates that there is ready another ship to take the place of a wounded ship, and the effect would not be bad if the officers and crew were not to return to

their first ship. But in the process of transfer from, then to, the personnel gets somewhat shaken up and separated and ordered away, and the organization does not return to the first ship quite the same as it left it. It takes many months, not a few months, but many months to develop the organization of a battleship, to arrive at that point where every officer and man has found his proper niche, every round peg in a round hole, and every square peg in a square hole, and to solve problems of routine necessitated by physical qualities of the ship. One can go farther and say, that it is of some consequence to the temper and spirit of the men that day after day, for example, one man will have tacitly secured a right to a certain spot where he becomes accustomed to sit on his ditty box, or some auxiliary watch keeper will feel a comfortable possessorship in a six by two area where he is wont to spread out his newspaper and "caulk it off." Such is the complexity of the battleship's organization that the personnel becomes a very delicate element. If it occurs, in the fortunes of the sea, that one of the active fleet needs extraordinary repairs, she may possibly be set back a year by a disruption of personnel accomplished with the stroke of a pen. It is a question whether we have made reasonable progress in gunnery, in hitting, in very recent years. If we have not, it is partially accounted for by a constant upheaval of officers and men, possibly unavoidable, but opposed to progress.

The occasional attitude of ships towards ship's commissary departments might be said to be rather commercial. There was prepared several years ago, under the direction of a commandant of one of the training stations, an excellent manual, which, if followed on board ship, offers the best known means of getting the best out of our abundant navy ration. It is possible that some of the commissary officers have never given it much attention. It is possible that some of the commissary stewards have never seen the manual. It is possible that some of the ship's cooks and bakers do not know of its existence. Instead, in the occasional ships, there seem to be two ideas, one of which usually dominates the commissary department. One is that, when inquiry is made as to how the general mess is getting along, the answer is—"there are no complaints." Now the prevailing type of our man-o'-warsman is an uncomplaining man. He will put up with a lot. So in those commissary departments whose standard is never to hear a complaint, it can be surmised that whenever a complaint does come, conditions are poor.

The other objectionable idea is that the commissary steward hopes some day to receive from the crew a diamond-studded watch charm. It is the influence of this latter idea, which is purely a commercialized attitude toward duty, that may help to breed the spirit of graft.

It would not be fair to allow these observations to give the impression that the two ideas mentioned are the prevailing ideas. That is not so. On the contrary the majority of our general messes are examples of the best exhibitions of devotion to duty.

And furthermore, it ought to be said here that the foreigners see in our commissary departments and general messes a development to a point of excellence none of them have yet been able to reach.

But there is no reason why every ship should not have as the only standard in the general mess, that resulting from the standpoint, that it is a matter of plain simple duty to deliver at the men's mess tables the very best output that our galleys, with the abundant navy ration to work on, are capable of.

Whereby we may rely on the obligations due from the commissary department to the crew, not on the obligations the crew come to imagine they are under to the commissary department for running a fine general mess. This will result in the contented feeling on the part of the men that, anyhow, the general mess is doing the best it can in the best spirit.

Another example of naval commercialism may be said to lie in the neglect occasionally observable on the part of the executive officer's office to keep proper account of the expiration of petty officers' acting appointments, and of the end of the periods in other ratings where a decision affecting the present and future of the man ought to be made. Many executives will recall cases where petty officers *apply* for permanent appointments, when the executive's office should have been "on the job" to the end that the decision would be made *without* the man being obliged to apply for it. This tends to commercialize promotions in this way: Either a deserving man comes to see that nobody is looking out for him, or else less deserving men get the idea that promotions are to be had for the asking, and this results in some cases where the applicant in the end turns out to have had a persuasive manner and more aptitude for the money than for the duties. This cannot help but breed a low estimation of promotions and the system

by which merit is not recognized until the deserving has to ask for it. The result is that chief petty officers must *ask* for their next promotion, that is, for the examination for *permanent* c. p. o. appointment. This is not the correct principle. Every acting c. p. o. should have his case taken up and decided on its merits whether the c. p. o. requests it or not. It would be well if the Department would rule that they themselves would refrain from occasionally giving a man a rate because he asks the Department for it. Authority to promote in excess of complement covers all cases pretty well. The men should be bred into a confidence that *no* rate comes for the asking, but that *all* rates are practically, as they are thought to be theoretically, the pure results of a standard system of selection on merit.

And in this connection an executive will occasionally have a division officer complaining that petty officer so-and-so is inefficient. And when we come to look into the record of the man we will find that the division officer has been giving the petty officer a 4 in proficiency in rating. Now what does a 4 mean when translated into words? It means "very good." Or, a division officer may recommend some youngster for discharge as undesirable, and the division officer's own proficiency marks will show by average that the man has been rated from "good" to "very good," from 3 to 4. Or, a man goes out with an ordinary discharge with an "obedience" mark averaging from 3 to 4, "good" to "very good," and yet his record is such as to leave no question but that he is not entitled to an honorable discharge. Or, a man goes out for a recommendation for a good conduct medal simply because, in that column, there are more yeses than noes. Now a good conduct medal means more than an honorable discharge; and it should not be understood that simply because the man has a clear record for the quarter he should necessarily have a "yes" as recommendation for a good conduct medal.

It would be better to abolish the quarterly recommendation for good conduct medal and the quarterly recommendation for character of discharge, and require those decisions when the man is paid off, by a careful survey of the entire record, particularly as now-a-days many men are transferred from ships so frequently that they not only have not time to buy new cap ribbons, but they are not long enough aboard the ship to become known. These things are submitted as tending to commercialize the standards

that should exist, and they are undoubtedly inconsistencies. Take for example a petty officer recommended to be disrated for inefficiency. An examination of his record shows a long string of 4.0 quarter after quarter. That inconsistency is hard to explain. We ourselves know that a reduction in rating for inefficiency usually occurs after a known accumulation of exhibitions, none of which perhaps were made matters of record in the process of their accumulation; but the man's marks in the meantime should have been consistent with his value. If it can be said that there is so much to enter on the man's record as to result in the physical impossibility of each subject being carefully considered, then it might be better to simplify the record so that the entries which are of great concern to the future of the man shall be consistent, with as much regard for navy requirements as they should have for the man concerned.[1]

One of the subtle influences at work adverse to naval manners and customs is the present day commercial method of addressing and signing correspondence, in which naval titles are suppressed. A mess attendant to-day, in writing, addresses a rear-admiral in the same manner that the rear-admiral would address the mess attendant, if there were cause for such communication. It is inconsistent not to have the formalities of official correspondence in harmony with the formalities of official intercourse. The spirit of a fighting organization cannot flourish amid inconsistencies.

Those whom in official intercourse, we address as "mister," should in written intercourse be addressed as "sir." The senior officer should subscribe himself "respectfully" in a written communication to the junior, and the junior should subscribe himself "very respectfully" in a written communication to the senior, and in a written communication to an enlisted man the superscription, as well as the salutation, "sir," should be omitted. This is old fashioned, but old fashioned things should not be supplanted by things which, though having some form, have not the substance.

And there are some further influences at work tending to socialization. It can be observed now-a-days that there is to some

[1] The recent excellent standardization of enlistment record markings devised in the Bureau of Navigation will wipe out most of these inconsistencies.

extent, indiscriminate social intercourse on board ship between ward-room officers and junior officers on the one hand, and officers of the warrant officers' mess on the other hand; and that warrant officers who have been commissioned as "chiefs" expect, in some cases, inclusion in events to which "commissioned officers" have been invited in an official capacity. This is a subtle tendency, incompatible with the separation of ranks and grades on ship-board, which, as an established principle, is fundamentally sound and necessary to naval discipline. It seems necessary to say, that we should not hesitate to recognize this tendency; and seeing it, we should firmly break it up. Ward-room and junior officers should be prohibited from visiting the warrant officers' quarters, and the warrant officers should be prohibited from visiting the junior officers' quarters. No junior officers' mess should be permitted to maintain a wine mess. With the historical carelessness of Mr. Midshipman Easy, they are apt to allow empty beer bottles to lie about, which is a spectacle calculated to demoralize those men whose duties take them through the junior officers' quarters.

And further, officers of the warrant officers' mess should be forbidden the privilege of the ward-room wine mess.

The Navy is distinctly not aristocratic. The national institutions and the democratic system of recruitment of both officers and men preclude that. It is a *classified* service. Theoretically its different classified grades are reached on merit. One of the qualifications for promotion up the grades is the character to meet the increasing responsibilities. One of the increasing responsibilities is the ability to set a good example, in the expectation that naval discipline will be healthier if it depends on following the example of our elders, rather than on being awed by "Such punishment as a court-martial may adjudge." And if example is to be telling, "familiarity breeds contempt." Youngsters and juniors must develop under restraints. Restraints are preventives. Good naval discipline is founded on preventives, not on correctives. (The best naval discipline has for one of its expressions the fewest reports at the mast.) To insist on a dignified unfamiliarity between the officers of different messes is not aristocratic or snobbish, it is nothing more than naval discipline on a sure foundation. There are hearts of gold and nature's noblemen in every walk and class in life, in the Navy as everywhere else, and when we see one of these fight his way up from naval apprentice into the ward-room,

while we may have kept him at a dignified distance when he was in the warrant officers' mess, we ought to be proud to welcome him into the ward-room when he earns his ensign's commission. And that our navy can have its self-made man, as well as can civil life, constitutes a potential strength which we may be sure is not over-looked by any of the world's foreign offices.

The Navy of the United States has been an armed industrial organization from its earliest days. There never yet has been much that is military about our navy. From the days of Paul Jones, when the *Bon Homme Richard* was an Indiaman (built for an industrial career), pierced for a battery, down to the present day the Navy has been a fighting industrial organization. In a restricted use military pertains to soldiery. The only things military about our navy to-day are the Naval Academy, the training stations and the Marine Corps. Our young officers and our young man-o'-warsmen are bred under a *military system* for the *naval* service, and much of the *military spirit* disappears when they get aboard ship and find that the military end of the profession is occupied by the marines and the masters-at-arms.

Our crews are law-abiding citizens. So would any aggregation of industrial workers be who were domiciled on board a ship of war with an independent and specialized "ship's police." It is convenient, and in harmony with naval industrialism to save the men from the cares and responsibilities of "police duty," by continuing the antiquated marine guard (officially called detachment now-a-days, but still spoken of by the marine officers as "the guard") and the masters-at-arms. (A distinction should be made between the term "police duty," which under the military system is a "detail," and "ships police," which under the naval system is a "specialty.")

It is in harmony with naval industrialism that we have not a workable manual of guard duty for ship board. It is in harmony with naval industrialism that the entering wedge of progress in naval discipline was withdrawn when the man-o'-warsmen were within these last two years prohibited from doing the small amount of guard duty, which, several years ago, was instituted with true instinct as to what constitutes the fundamentals of naval discipline.

Now from the earliest times a *military* system has evolved itself as the best means known to human experience through which to instil that *esprit de corps* which is essential to any armed force.

And any armed force which is not maintained under a military system is not under the true system through which the highest spirit of the service can be achieved. Moreover one armed force without a military system, having its laws and orders enforced through another armed force with a military system, can never feel the truest *esprit de corps.* No questions of expediency or military or naval commercialism can satisfactorily account for the continuation of the marines in the complements of our ships. This pressing reform in the Navy might not be quite expedient, but it appeals more strongly to-day than when sixteen years ago it was first proposed by a far-sighted master of naval discipline. And it will continue to press as a reform, until it is admitted and recognized.

And had it been effected then, two years later, in 1898, it is probable that the commander-in-chief, off Santiago, would have had under his command in *independent transports,* a sufficient force of marines so that early in June a successful assault of the marines, supported by the army advancing westward along the beach, would have carried the Santiago Morro, would have swept the channel of mines, whereby the Spanish would have been taken in the flank supported by the *secondary batteries,* as the ships would have then been able to enter Santiago harbor, their main batteries taking care of the Spanish ships. And the surrender would have shortly followed; whereby hundreds of American soldiers would have been spared death from disease in the United States trenches. But instead, what? The Marine Corps then, as now, opposed the reform for its own reasons. The marines were scattered about at the ships' secondary batteries, and could not be massed for the shore assault without *unmanning the very guns which were necessary to support that assault.*

If the Marine Corps is going to continue to be successful in opposing its concentration for its primary duty, we will surely some day have history repeating itself.

This proposition must only be approached with the broadest view and in the sincerest conviction that marines on board ship not only stand in the way of naval discipline, but also stand in the way of that concentration without which the corps can never be utilized to the extent to which it is capable.

History or practice does not support even the expediency of embarking the marines in our battleships. Every expeditionary force

of marines we have moved in recent years has been moved in transports, excepting when the battleships have been diverted from their routine cruises to themselves serve as transports. A battleship can berth only so many men. Every man she can carry must have a battle station. What sort of a condition will we leave our ships in when the marines disembark as an advanced base force, and, possibly in the face of the enemy, thus leave a part of the battery unmanned? This reform was almost unanimously supported four years ago by the Navy, whereby is illustrated that the Navy itself understands the oppression of naval *esprit de corps* in continuing the marines for guard duty in our battleships.

When the marines are removed from the battleships and embarked as organized battalions in transports outfitted for all demands of advanced base duty and expeditionary duty, then will we have a *military* navy, and the military system under which our young officers and young man-o'-warsmen are being bred must be extended to embrace the whole navy, and one feature of naval industrialism will disappear forever. The next consistent reform to come will be the abolition of the rating of master-at-arms. No sincere advocate of the debarkation of the marines can insist on retaining the masters-at-arms. These, as such, remain an expression of naval industrialism, and continue as much a specially privileged class as the marines. What is known as the "police duty" of the ship will then be imposed on all the petty officers by roster. What answer would we get to this question put to a colonel of artillery, "Colonel, what would be the effect on the artillerymen here in your command, should we detail a company of marines to do your guard duty?" Suppose we would put this question to a colonel of marines, "Colonel, what would be the effect on the marines here in your barracks should we detail a company of bluejackets to do your guard duty?"

In trying to be persuasive, suppose we should again ask the colonel of marines, "But, colonel, we consider it a part of the necessary training of our man-o'-warsmen that they should have periodical guard duty in the marines' barracks so as to imbibe some of the 'military habit,' just as you think that the marines should have periodical guard duty in the battleships in the expectation that they will thereby imbibe some of the 'sea habit.' Cannot you consent to that?" Is there any doubt as to what would be the answers? It is probably correct to say that military men regard

the manual of guard duty as the holiest and most sacred of all the manuals. It can easily be said that the manual of guard duty is the text book of *esprit de corps*. Yet such a manual is not known on board the man-of-war. All this is why we are not a military navy. There are navies that are military navies. They do not embark marines and turn the guard duty over to them. They have begun under fundamentally correct military principles, and we know the *esprit de corps* of those navies is of a high order, and whenever we fall in with the ships of those navies we are impressed with the manifestations of the spirit and discipline of their men.

No proposition can be a reform sixteen years ago or four years ago and not be a reform to-day. Every proposition having to do with the elevation of character can be called a reform when it will stand the analysis of human experience. This is a reform from the standpoint of naval discipline, naval *esprit de corps,* and it cannot be destroyed, though through expediency it may be delayed in being put into effect. Once a proposition is admitted as being for a positive human uplift it becomes a reform, it always remains a reform, it cannot die and it should be constantly fought for. It is not at all impossible that naval legislation can be just as easily influenced in favor of " special privileges " within the Navy, as tariff legislation can be influenced in favor of special privileges dominating politics; and we would then have an example of legislation partaking of the character of naval commercialism. The man-o'-warsmen were commercialized when the reform to place them under a *military* system by removing the marines from the ships was temporarily prevented by legislation.

The difficulty will always be in trying to accomplish this reform, that while the Navy's purview would include the sphere of the Marine Corps, the Marine Corps confines its view to the Marine Corps only, not a navy view. The standpoint seems to be the fear that it will mean the loss of their identity. There is undoubtedly no occasion for any such fear. The Marine Corps is too firmly established. It has always had its particular place as an arm of the Navy. The Navy cannot do without it.

It can be confidently asserted that the non-commissioned officers and men of the Marine Corps manifest an *esprit de corps* more highly developed than is to be found in the rank and file of any of the armed forces of the United States. This splendid spirit is

justly admired everywhere, and is a valuable asset to the country. It is but natural that naval officers, with enthusiasm for their own men, recognizing the unreached possibilities in a free development of their own men, should seek to develop the spirit of their men under a system which has brought about such fine expressions in the other arm of the Navy.

As *esprit de corps* develops, pride in the service develops. Discipline from every standpoint improves, because character improves. Elementary behavior improves when character oppressions are lifted. A more useful attitude toward the service will ensue because necessary restraints will then more consistently appeal to intelligences with greater reasoning powers to-day than had the intelligences of sixteen years ago. From this standpoint the proposition is, broadly, a moral proposition. And more than this; this proposition not only constitutes a *moral reform*, but it is a *military measure;* just as sound as the principles under which an army is composed of the infantry, artillery and cavalry arms, each independent in its own well defined sphere, but co-operating and co-supporting.

It is apparent that the Marine Corps to-day, when thinking from a navy standpoint, realizes that its proper field is in that of the naval advanced base. The following quotations from *The Naval Advanced Base,* by a marine officer who has given the subject thought and study seem to support this contention. (Writing of the establishment of a temporary base) "Every man aboard the fighting ships would be needed, not one could be spared, and the lot of establishing and defending the advanced base selected would fall to an expeditionary force carried in transports along with the fleet." And again; ". . . . the establishment of the advanced base would have to be carried out with great despatch, and in the face of the enemy, ..."

And again; ". . . . that some of the battleships might remain at the selected base for its defense, but this is not the purpose of the battle fleet—*its whole object in existence is to capture and destroy the enemy's fleet* . . . ." And again; ". . . *fleet* . . . .must contain . . . . a thoroughly equipped and trained advanced base force, ready to accompany . . . ." And just here it might be observed that the only way to thoroughly equip and train an advanced base force is to equip and train it. Every period of service in a battleship, while nourishing their *esprit de corps,* is time lost so far as

advanced base training is concerned. For in the battleship the marines get less "sea habit" with man-o'-warsmen to do the seamen's jobs than they would cruising in a transport, put to it to do all their own seamen's jobs; and further the torpedo defense fire ocntrol which they learn in the battleship is of an entirely different order from the shore battery fire control they must learn on the advanced base defenses. And why not concentrate them on mastering the shore battery fire control they will have to use. And again; ". . . . no one in the naval service is prepared in all respects to undertake the work required to establish an efficient advanced base;" And, it might be observed here that so long as the marine's tour of duty in the battleship counts him eligible next for barracks duty, then they will *never* learn the advanced base work so long as they are carried in the complements of our ships, particularly as an increasing amount of expeditionary duty further interferes with advanced base training. But as soon as transport service and advanced base assignment becomes the marine's *sea* duty, then will the Marine Corps *learn* advanced base work.

And again; ". . . . the ships of the fighting line can carry only sufficient men to man the guns and engines in war time, and that no one can be spared to man the defenses of a shore station be it ever so important." Which points out that we are carrying upwards of two thousand marines in our ships' complements which to-day should be putting in their sea service organized into two regiments learning advanced base duty; and these regiments should be relieved by others at periodical intervals, and naturally they would be, all being trained successively in the one modern reason for their existence. Then the writer says that "it had been . . . . at once recognized that the officers and men had had no special training fitting them . . . ." and "in 1901 guns were taken from battleships and mounted on shore by marines," and now eleven years after, they are no farther ahead. Does not this show that they will not learn their advanced base duties until removed from the battleships and embarked in advanced base work? That their battleship service interferes with any advanced base *practical* work? Then the writer says that to promote in the Marine Corps an understanding of advanced base work "requires . . . . a realization that 'the old order passeth,' and that new duties, and responsibilities appear." Undoubtedly. And again; "In the old days the part assigned to the marines was to be a sharpshooter

in the tops and along the rails, ... a rôle that has disappeared as completely as the swash buckling topsail yardman of the frigate of 1812." Undoubtedly. And finally to paraphrase a quotation we may say: "Hence if the" man-o'-warsman "of the future is to act well his part in the drama of naval warfare" . . . . "he must receive an essential part of his training aboard the ships," (and combining with this another quotation) and "must at all times be under the military command of their own officers, to secure the proper control, discipline, and uniformity of action." This is only applying to the man-o'-warsman what is suggested as necessary to apply to the marine.

As long as we remain an industrialized navy, the complexities of our organization are going to increase. When we begin to have a homogeneous ship's company under a *military* system, little by little we will learn how to replace complexities by simplifications; and the hundred and ten ratings that now appear on our complement sheet, we will find to slowly amalgamate, and diminish in number, at least to some extent.

The increasing size of our ships and the physical difficulties of exercising that penetrating command of the officer of the deck requisite in a man-of-war, suggest study with a view to organizing a duty detail best exemplified in the *seaman guard;* whereby, in time, will be included duties now done by masters-at-arms, quartermasters, boatwain's mates of the watch, the anchor watch, the side boys, the messengers, as well as the *petty officer of the guard* and *sentinels,* all duty details which experience will demonstrate, both underway and at anchor, can in time amalgamate and get away from specialization. This navy trade unionism, whereby we feel that only special rates can do the name duty, is one cause for our extravagance in personnel—more people than we need to get along with, in peace time. Then we will have an organization equal to peace demands and capable of expanding without upheaval for a war footing. Something like, though not quite yet so simple as the expansion of a peace strength regiment of field artillery to a war footing strength, but on the same principle. This may be a dream but it is not impossible. And anything not impossible can be achieved, provided the organization tends toward that achievement.

It would seem now, on looking back, that when, four years ago, the ships' marines were landed and military duties were confided

to the men, the *seamen guard* organization by which this was instituted was defective in being approached from an incorrect standpoint. The masters-at-arms were increased which was incorrect. An attempt was made to give a whole ship's division at a time guard duty. This was incorrect and naturally threw ship's work out of balance. No standard manual was devised for guard duty on ship board, whereby the dignity and elevating influences of guard duty would have become standardized and impressive. The result was that the seaman guard was not organized in a direct simple manner, by detail by roster from all divisions, in accordance with the best practice and experience as found in our manual for the landing force. Had it been so approached, the seamen guard would have been no more troublesome than a "working party." In fact it would have been a dignified "working party" for a twenty-four hours tour of duty. Consider, approached from this standpoint, what opportunities for gradually including in the seaman guard all the seaman duties and all the military duties including shore patrol, that readily lend themselves to a perfect combination; which in a homogeneous organization would be accomplished eventually by fewer men than we now require to accomplish them! This appears to be organization. This is nothing but "scientific management" applied to the handling of men.

The tendencies of the present-day navy manifested by the suppression of old navy manners and by a trend toward socialization need not be said to be an unfortunate sign. For the high qualities of character and intelligence in our modern man-o'-warsmen, in simply seeking independence and the freedom to develop, are impelled by a democratic inheritance; and if they are not led, in this instinctive effort of human nature to develop, along lines directed to the strengthening of the spirit of the future navy, their unconscious ambitions will find inconsistent outlets, which to their natures are the easiest. And if our organization does not keep pace with this ever improving quality in the men, then we are not getting out of them and into the Navy the best of which those men are capable of being led to give.

This tendency toward socialization—toward a levelling of ranks and ratings—is partly the inevitable result of a system opposed to breeding that military spirit which we associate with war energy. Where the proper balance is not preserved between things material and things spiritual, and where the pendulum is allowed to swing

so far as to place undue emphasis on the things material, it becomes easy and natural to relax the methods whose daily unseen influences habituate men into a condition which is known to a military organization as discipline.

Thus we allow ourselves to drift into a state where we become incapable of demanding high standards of ordinary duty in our men. To illustrate: To a private of marines we will give a general court for going to sleep on watch. To a man-o'-warsman, guilty of the same dereliction, he may be penalized in any degree from extra duty to a summary court. Does this express on our part, on the part of the officers, a recognition of high standards? If we do not demand of the men high standards in matters of common duty in time of peace, have we any right to demand of our torpedo defense watches a bright lookout in the dead of a cold, rainy night in time of war,—on a night after a day's action wherein men's mental, moral and physical powers had already been strained to the utmost? If our methods do not, in time of peace, instil into the men a recognition of the dignity of the Navy—of every duty that must be demanded of them—can we expect them to be trained into that mental and moral attitude upon which the Navy must rely in time of war?

Still there is a comforting and better side to it. This tendency toward navy socialization indicates that the men in respect to intelligence and personal qualities, are overtaking the officers. This is entirely in harmony with democratic development. We can surmise what will be the outcome in some future generation. The Naval Academy, as such, will cease to exist. The training stations will succeed the Naval Academy. The officers will be recruited from the men, and the institution at Annapolis will then become a vast postgraduate school. Already the signs point that way. Can anyone deny that this is the ideal? Will not the nation then have in its personnel of the Navy the intellectual and mental forces that should make the Navy of the United States the most powerful the world has ever dreamed of? But intellect without the military spirit will not win battles.

It cannot be denied that, while the average officer in professional scope (due to the material expansion of the Navy) is the superior of the same average of sixteen years ago, the average to-day in the personal qualities of the men is vastly superior to that average in the men of sixteen years ago; so that, to-day, there is not that

same intellectual gulf between officer and man as existed formerly: and it is narrowing from year to year. So, from year to year, while these qualities in the average man are slowly elevating themselves toward the level of the same qualities in the average officer, and *beginning now,* naval discipline will require each officer to earnestly strive to attain those particular qualities of heart and mind and personality that in the last analysis distinguish men who are fit to be *officers,* fit to command man-o'-warsmen. These, in our navy, can be the only qualities that separate the officer from the man. This should be the spirit that should come to consciously prevail among the men—that their officers are their officers by virtue of their personal qualities; and not because chance gave them a Naval Academy education and placed them, perhaps in spite of themselves, in line of promotion.

We must not say that our obligation to the Navy ends with the navy of the present; for if true statesmanship builds to the end that the nation may endure in power and prosperity, then the true *esprit de corps* of the Navy must maintain that firm, unyielding, consistent, just, impartial, uniform, *military* system by which, only, the Navy will grow in moral and spiritual power as time goes. This, only, will distinguish a military establishment from an industrial establishment. This can only be expressed through *military* organization and naval routine and regulations, naval manners and customs. These also must be the influences in our daily life on shipboard; and these are what come to be comprehended in the term *naval discipline.*

From time to time, as the man-o'-warsman develops, restraints can gradually be ameliorated. To this end our minds should be constantly on this subject, that we may get the best out of the men by lifting restraints as their characters develop. Ameliorations we have witnessed and are witnessing; but no just and necessary restraint can safely be lifted until we are satisfied that the *average* man-o'-warsman has been developed to the point where naval discipline will not thereby be shocked.

This points to another manifestation of naval industrialism. What appears to be needed in the service to-day, is not so much a minute standardization of punishments, operative only on a small minority of the men, but a standardization of privileges, restraints and limitations, operative on the entire body of the men; as free, and as generous and ameliorated as is possible—which goes with-

out saying, consistent with the military ends of the Navy and with the present stage of development of the characters of the men. This competition among the ships to see who can have the most "contented" ship, is the inevitable result of a discipline constantly drifting farther away from that which should inhere in a military organization, toward that which most readily harmonizes with the spirit of an industrial organization—with the material and commercial aspirations common to activities in civil life all over the country to-day. This is perfectly natural, when one reflects that we are still carrying two bodies of men in our ships' complements, differently commanded and differently uniformed; one, the marines, in which is emphasized military standards, military duties and military relationships; and the other, the man-o'-warsmen, in which is emphasized industrial standards, industrial duties and industrial relationships. In military life there comes military contentment because military instincts and relationships suppress social instincts. In industrial life there is no such thing as industrial contentment, due to the injustice of our economic laws; that is only a lesser degree of industrial discontent. Industrial discontent is the outcome of the social instinct. What might be called industrial contentment is an inactive industrial discontent. In civil life it always smoulders. It is breaking out now here, now there, all over the world, but whether active or inactive it is always there. The shipboard social instinct is human. It is that quality in our brand of human nature that must, in the Navy, be subjugated by the military system, and brought into conformity with military relationships. It is inconceivable that we can mold our human nature into a human weapon unless we bring into subjection those human instincts that are opposed to military standards. The social instinct in its full and complete development is socialism. As a political creed, socialism is openly opposed to the military instinct. It is for peace by equalization.

Therefore, it would seem true, that in our anxiety to promote contentment we are, in some cases, unconsciously impelled by industrial motives, and not altogether guided by military instinct. We are constantly interested in what this other or that other ship is doing in the way of extending privileges, in the feeling that we must go her one better. We are frequently having requests, which mean to relax a little here, or to relax a little there, because "they do it in" some other ship; and this breeds in the officers and men

the belief that the Regulations can be set aside as the captain deems expedient. There is a lack of uniformity in this respect among the ships, just as there is a lack of that uniformity among industrial organizations ashore.

This is the manner in which naval discipline is giving way to industrial and commercial expediency; and the reason for it lies in the system wherein, in carrying the marines, we come to try to gain military ends without using military methods.

All this does not apply to the excellent institutions under cognizance of the Fleet Regulations; but it applies to the whole range of limitations, restraints and privileges, which, rapidly widening and rapidly easing up from year to year, not standardized, not held in one firm grip, but decided as individual ships deem expedient, seem to be carrying us farther away from the influences of standard routine manners and customs; tending to lower the standard of naval duties that are not strictly industrial duties.

Military contentment is an asset. One illustration of the superior value of military contentment to elementary discipline lies in the fact, that on board of our ships carrying marines (when the marines are ably commanded), among them, petty infractions of rules and regulations are rare; while among the man-o'-warsmen in the same ship delinquencies against order, routine and regulations are relatively frequent, many of which never come to be placed on the report book.

Undoubtedly it is unavoidable, that, in times of peace, our recruiting posters must make their appeals through offers of industrial opportunities; but we should take care that subsequently, the industrial and material outlook should not only not be magnified, but should rather be gradually subordinated to the true spirit of the service, whose only outlook is that the end of the Navy is to win battles against odds. It is our business to develop a naval discipline that will win our battles *with the odds against us,* at the same time to keep it in complete accord with democratic standards and democratic aspirations. This we cannot do when our naval discipline remains in accord with monarchic repression.

Good naval discipline is good strategy. To study naval discipline is to study strategy. And so it can be correctly inferred that our imperfect naval discipline is at bottom on a wrong foundation, due to the deep, subtle, unseen influences of the system whereby, in our otherwise advanced and otherwise enlightened

navy, we carry marines in our complements. It is bad strategy; but because we have won our battles in the past in spite of bad strategy, there is no justification in continuing bad strategy.

The Marine Corps at present is an unorganized corps, whose units must be hastily built up when emergency demands. It should be organized from top to bottom into regiments, battalions and companies, distinct and constant units, for the sake of greater cohesion from constant association in service. The battleships should stand ready to embark them, if that seems the most expedient, or in the absence of transports, a company to a ship, for expeditionary duty or for advanced base duty. The ships' organizations should stand ready to berth and mess them, and storerooms should be designated which can be quickly vacated for storage of the company's impedimenta.

But this naval discipline demands: When thus embarked for transportation, the marines must not have any duties concerned with the day to day life on shipboard not incident to their embarkation, or any duties concerned in the slightest degree with the handling or discipline of the man-o'-warsmen; nor must they have any station in the battery organization, for those are the guns that must support their landing. The primary duty of the Marine Corps is distant shore service. The primary duty of the battery is to meet the enemy's ships. This is all good strategy.

Thus it may be said, that, to prevent the socialization whose influence has always been to weaken the military ardor, and at the same time to utilize fully the intellectual forces which bring about that very socialization, naval discipline demands two things.

First: That the *ranks,* the officers, must themselves strive to reach a high standard of culture and refinement in order that the gulf between them and the *ratings,* the men, shall be maintained to the end that *commands* come naturally to the one, and *obedience* comes naturally to the other.

Second: That the organization, limitations, restraints, and manners and customs which govern and define all the varying relationships of rank to rank, rank to rating, and rating to rating, must have underlying them thoroughly military principles and military consistencies; for mankind knows of no other system that can so well mold an efficient human nature into an efficient human weapon as the *military system.*

Ship organization can be said to come under tactics—it must be altered to use new weapons. The weapon controlled by organization is intelligence. A keener intelligence has given us a new weapon. The new intelligence which organization is to manipulate is capable of wider uses, greater results and greater sacrifices when it is required to meet military obligations as well as industrial obligations.

Naval manners and customs can be said to come under strategy —whose underlying principles and influences are unalterable. The influences of naval manners and customs go into the spirit of the service. That has won our battles in the past. It will win our battles in the future.

Thus it seems clear, that marines on board our ships of the line, while they assist in the industrial development of the man-o'-warsman, stand in the way of his military development, and therefore in the way of naval discipline. Military spirit is only half-hearted at best, when there is a military development that, at best, is only half-hearted. Success in battle would not appear to tax the military spirit, but adversity in battle would appear to call upon a naval discipline developed to the highest possible degree, if we would escape demoralization. The highest degree of naval discipline can be bred only strictly in accordance with what we understand to be meant by military principles. But whether it be success or adversity, no call will be made whatever on the industrial spirit; the demand will be made on the military spirit, only; even into the remotest coal bunker and into the remotest handling room. While the strength of the spirit of our service is derived from the victories of the past, we cannot ignore consideration of the future, when our naval discipline may be called upon to lift us over an adversity.

No discoveries are herein made. Rather has it been sought to emphasize the causes which appear to bring about the effects. Our elders recognize the effects. But admonitions are only temporary correctives. The simple truth would seem to be that we have out-grown old navy ship organization and have not found out yet the proper new navy ship organization. It is organization with all its influences that we must study as applied to the new navy man-o'-warsman. Transitory periods are dangerous lest the elders allow to become custom and precedent some things that by common experience are opposed to the spirit of naval discipline. This

is what each new generation of naval officers inherits, the *spirit* of it all; and this is what each elder generation of naval officers, holding firmly to the best out of the past yet with open minds in looking to the best for the future, must hand down, not only unimpaired but finer and stronger.

This is the conclusion. The modern navy should be working under a system that will tend to achieve just the same homogeneity in the crew that we are achieving in ships of the fleet, and in the batteries of the ships. The modern man-o'-warsman should be under a *military* system to the end that homogeneity can be had only that way. The military spirit—the martial spirit—should be bred hand in hand with the industrial spirit; not to emphasize unduly militarism over industrialism, nor to allow industrialism to tend to displace naval manners and customs. Thus would we eventually have such a MAN-O'-WARSMAN as the world has never before known! Then we will have a MILITARY NAVY!

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ORGANIZATION OF THE SHIP.

By LIEUT.-COMMANDER A. M. PROCTER, U. S. Navy.

Good organization is a very desirable, but not an absolutely necessary, adjunct to successful administration. Organization of itself will accomplish nothing. Good administration will often produce successful results in spite of a bad organization.

Under the primitive conditions of the past there has been less necessity for a knowledge of the science of organization. Supply follows demand, and the practical necessity for this knowledge is attracting the attention of thinking men the world over. Administration as an art is very old. Organization as a science is very new. That which often passes for good organization is high class administration, through splendid personal equations, of what is, in fact, unscientific organization.—*Modern Organization* —HINE.

We have had in the navy many examples of successful administration, but when we analyze the conditions existing on board the modern ship, we are forced to the conclusion that we have nothing which can, with any propriety, be called an organization.

In a proper organization we find a grouping of personnel into units under appropriate leaders, and the establishment of lines of authority by which the head can control the personnel as a whole by dealing with appropriate subordinates. In the organization of our ships, we find an accidental grouping into units of various sizes, but when we attempt to trace the lines of authority through the various elements we are involved in hopeless confusion. The present organization cannot be diagrammed. An attempt to do so at once discloses the correctness of these statements.

We have attempted for a great many years to produce a "station bill" to cover the various requirements of ship life, and there has been a very general belief that in so doing we were effecting an organization. Making out station bills is not organization, and the necessity for them is the result of the fact that, having no

organization in which the authority of leaders is established, and in which it is possible to hold these leaders responsible for the production of the required results, it becomes necessary to issue detailed instructions governing the conduct of every one on board under every possible circumstance.

The present organization is the result of evolution, but partially complete, from the organization of sailing ships—an organization admirably suited to the requirements of the day, in its final form, which it reached just previous to the Civil War. The change has been painfully slow, but we have progressed far enough to be able to see that we will have in the near future an organization from which the last vestige of the character imparted by the sailing ship will have disappeared. We are slowly progressing towards a solution which is not the result of design, but which is being forced upon us by the necessities of modern conditions, and we now have it within our power to say whether our organization shall be in accordance with correct principles, or whether we shall continue to do as we have done in the past, and allow it to take a form determined by a mixture of tradition and pure chance.

The organization of the sailing ship of war was a result of expediency, due to the fact that, in the beginning, several hundred years ago, the officers were not seamen, but fighting men.

The officers of the organization of our ships, as it existed at the beginning of the last century, were: (1) The commander, (2) the lieutenants, (3) the master, (4) the midshipman, and (5) the warrant officers. The order of rank was as shown here.

The lieutenants were all senior to the master, who was not in line of promotion, and were primarily charged with the duty of fighting the battery. They were watch officers, and practically all the regulations referring to them specified their duties in charge of the watch. It is not apparent that they had any duties or responsibilities in regard to the ship.

It might be inferred that the master was subordinate to the first lieutenant, for organization purposes, but this point is not clear. The master was charged with the care of the ship, and had as his assistants for this purpose four warrant officers, each in charge of a department.

The boatswain was in charge of the deck force and responsible for all parts of the ship manned by this force.

The gunner likewise was in complete control of the battery.

For general quarters the division officers—the lieutenants—assumed command of the battery.

With the retreat from drill the control passed back into the hands of the gunner. The carpenter and the sailmaker were, in the same manner, responsible for their departments.

The master was specifically charged with all the responsibilities which were, at a later date, assumed by the executive officer. He was, in reality, the master of the ship. He was the navigator; and it is probable that he maneuvered the ship in battle, under the orders of the commander.

During the hundred years that have elapsed since that time, the first lieutenant has become the executive officer. The master, his duties taken from him by the first lieutenant, became a subordinate officer in line of promotion, and finally disappeared. The first lieutenant of the present day and the ordnance officer have recently been added.

With the establishment of the bureau system, ship's department's corresponding to the bureaus in Washington, were established. The gun division gradually appeared as an administrative unit.

During all these changes, many of the old forms have been adhered to, and paragraphs in the Regulations, referring to the duties of officers, have persisted many years after the status of these officers had been completely changed.

The word "department," at present used in the Regulations, is nowhere defined, and is an illustration of the existing confusion. By the last edition of the Navy Regulations, the boatswain is still required to report his "department" to the executive officer.

The gunner is still required, in the care and preservation and use of ordnance material, to comply with the "Ordnance Instructions," a publication which has been out of print for over thirty years.

The height of absurdity is not reached, however, until the sailmaker's mate, the sole survivor of his race, reports in solemn compliance with Regulations for the Government of the Navy of the United States, 1909, that his "*department*" is secure.

The master-at-arms, an official forced by necessity, owing to the character of the crews with which our ships were manned, has been retained through all these years, with undiminished

powers over the conduct of the crew, until we have the horrible spectacle, in a military organization, of a coal passer, rated by virtue of brawn, exercising supervision over the conduct of chief petty officers of years of service and military training.

The present condition is a curious mixture of the old and the new. The situation, complex as it was, has been, during the past few years, still further confused by the superposition of a gunnery organization.

Since the revival of gunnery training there has been a tendency to treat proficiency in gunnery as an extra accomplishment, rather than a primary qualification. By means of extra ratings, and details carrying extra pay, a separate class of gunnery petty officers has been established; while the old ratings have been retained, with very much the same qualifications required in former days.

The statement that the gun division, at present, constitutes an administrative unit is but partially true. The division officer commands his division only at certain times and under certain conditions. He controls it for general quarters and fire and collision quarters, and the failure of the general station bill for these purposes having been complete, the usual custom is to require the division officers to make details for these duties; but even then we find very often a condition which requires the division officers to adhere to dispositions already made for them. There is no attempt made to effect an organization of the division. Stations are assigned to men individually, and there is usually no attempt at grouping them in such a way that men work under the same petty officers.

We usually find, in ship organizations, a recognition of the authority and responsibility of the division officer, but we also find that, for the greater part of the time, the division is performing duty under the orders of persons over whom the division officer himself has no control.

Under the present conditions, with the present chaotic mixture of ratings, proper organization of the division is impracticable. Complement sheets are made out without regard to any form of organization, and the formation of the men of a division into squads cannot be effected, in the absence of the proper number of petty officers of appropriate ratings. While the division officer has been given a partial control of his division for the purposes

stated above, there are other forces, with the weight of hundreds of years of tradition behind them, which act to make the establishment of the division as a real administrative unit, under the command of the division officer, an impossibility.

Generally speaking, the tendency is for the division to break up into a number of gangs, each gang forming around some petty officer with a title implying restricted usefulness as a nucleus.

The boatswain usually looks upon the boatswain's mates as his direct representatives. The gunner has similar views in regard to gunner's mates. The master-at-arms usually has direct control of mess cooks and compartment cleaners; and for purposes of exercising supervision over the conduct of the crew, he has control of all men of the divisions, and is entirely independent of the division officers.

The principal fault of our present organization is not that it is in violent opposition to all correct principles of organization, but that it fails to take advantage of the opportunity of training our officers and petty officers, by daily association, in the exercise of that initiative which they will be forced to exercise when thrown on their own resources by the accidents of battle.

Before proceeding to a discussion of the form of organization recommended, the status of the principal elements of the personnel which enter into it will be briefly discussed.

THE EXECUTIVE OFFICER.

The present position of the executive officer is the result of development from the first lieutenant of former days. The law does not require that he shall be the senior line officer on board, and it is probable that, while he inherited from the master his responsibilities in regard to the ship, it was the intent of the law that, in regard to personnel, he should be the aid to the captain, with very much the same status as the regimental adjutant, who is not necessarily senior to the company commanders or the chief of staff, who is not necessarily senior to the captains.

Whatever the intent of the original law, we find him, at the end of the sailing ship days, the senior line officer on board, and the actual executive head of the only line department on board, the deck department. When another line branch was established,

the head of this branch was made, not co-ordinate with the head of the deck branch, but subordinate to him. From the standpoint of correct organization this produced a situation which was radically and indefensibly wrong.

Without in any way making the executive officer responsible for the efficiency of the engineer's department, he was given a very considerable power over it. Executive officers were human, and many of them, with the best intentions in the world, were guilty of interfering in many ways with the efficient working of the engineer's department, due to the fact that they were unable to consider it from the viewpoint of an officer responsible for its efficiency. This fact was responsible for a large part of the friction which formerly existed between the two departments, and which was not entirely removed by the amalgamation of the two corps.

In labelling the new department a staff department, an additional error was committed which demonstrated a lack of clear perception of the real meaning and function of a staff corps.

It is not suggested that there did not exist, at the time, the necessity for an aid to the captain. It is merely stated that if an aid to the captain were established, his view-point should have been the same as that of the captain himself, and he should have been put in a position from which he could consider the efficiency of all branches of the personnel from the same point of view.

We are to-day guilty of many things which indicate a sense of faulty perspective. We have had, in the recent past, gunboats with battleship complements.

The importance of a command always has been, and always will be, properly determined by the number of men commanded. We find men commanding the enormous ships of to-day with the same ease and confidence with which men of former days commanded the pigmy ships of their day. The number of men who can be personally controlled by one leader, however, has not increased since the beginning of recorded history; and when the size of crews is increased, effective control can be exercised only by establishing a subdivision by which the commander is brought into personal contact with the same number of subordinates as before.

It is just as illogical to establish an executive officer, with all the powers of the office, on a third-class gunboat, as it would be to

appoint a company adjutant to promulgate the orders of the company commander. A third-class gunboat is little more than a company commander's command, and it is not too much to require of the commander thereof, to expect him to deal directly with the heads of the several administrative branches.

Whatever may have been the conditions at the time the executive officer was established, we have now arrived at a point, in the development of the modern battleship, where an aid to the captain is required, and where organization of the units subordinate to that aid is imperative.

The Regulations have recently been amended with a view to establishing this condition in regard to the duties of the executive officer. The executive officer is now established as the direct representative of the captain in maintaining the military and general efficiency of the ship in all departments. He is still, however, by being surrounded by a mass of detail connected with the administration of one of the ship's departments, prevented from preserving a proper sense of perspective towards the other departments.

It is a recognized principle, among students of organization, that the proper number of co-ordinate units which can be handled by one head is about four; the maximum number, about seven. If there are less than four, there is a temptation for the head to interfere in the administrative details which are proper for the subordinate to handle. If there are more than seven, it becomes impossible for the head to exercise even the necessary general supervision over the work of his subordinates.

At one time on board one ship of the fleet there were eighteen different heads, of a variety of units, who reported direct to the executive officer. And at the same time, on board this vessel there were three officers of the rank of lieutenant-commander who were not employed in any manner as part of the administrative organization.

FIRST LIEUTENANT AND ORDNANCE OFFICER.

These officers must be considered together. Their status is confusing and conflicting. They were both added to the organization as it existed, without in any manner establishing a place for them. They have certain general duties to perform and have, at various times and under certain conditions, authority to issue

orders; but they cannot be said to command anybody or anything aboard ship.

They are both concerned primarily with matériel; and, in order to perform their duties, they are dependent on the personnel of the gun divisions, without in any sense controlling this personnel, the division officers reporting direct to the executive officer.

The absurdity of the situation, in regard to these two officers, would be readily apparent if the same principle were applied to the engineer's department. Imagine for instance that there were no senior engineer officer, but that the division officers, commanding the engineer's divisions, reported direct to the executive officer. Then imagine two officers, co-ordinate in rank, each with authority to issue orders to subordinates; one responsible for the maintenance and operation of the motive machinery installed by the Bureau of Steam Engineering; the other responsible for the care and preservation of the compartments in which the machinery is placed, and of the machinery installed in these compartments by the Bureau of Construction and Repair. The resultant situation would not be different from the situation existing on deck, where a working arrangement is possible only when the three people concerned are pleasing to each other.

Generally speaking, the most glaring of our faults in organization are due to an attempt to organize around matériel; to establish lines of authority based upon bureau cognizance rather than upon the necessities of ship administration; and to preserve an unbroken control of bureau matériel, with a resultant mixed control of personnel.

It is the established policy of the Department to order a lieutenant-commander to duty as ordnance officer. Even if a place could be found in the organization for two lieutenant-commanders in the deck department, it must have been evident long since that the lieutenant-commander list cannot stand the strain. It is intended that the four senior officers aboard ship shall be lieutenant-commanders. Of nineteen ships attached to the Atlantic fleet on December 1, 1912:

One had four lieutenant-commanders.
Six had three lieutenant-commanders.
Five had two lieutenant-commanders.
Five had one lieutenant-commander.
Two had no lieutenant-commander.

Lieutenant-commanders ordered as executive officers are excluded from the above.

From the above it must be evident that it is impracticable to provide lieutenant-commanders for all details as "heads of departments," as established at present. From an examination of the situation it would seem to be inadvisable to attempt to do so. The proper basis for establishing a proper command for an officer is, as has been pointed out before, the number of men commanded.

Excluding the navigator, who is an officer with few administrative duties but with large responsibilities, there are two line commands proper for a lieutenant-commander on board ship. One is already established; the senior engineer officer commands the engineer's force, a battalion of about 250 men. The other branch, consisting of about 450 men usually designated by the meaningless term "deck force," is a battalion without a commanding officer. It would be entirely logical, and entirely in accordance with correct organization, to utilize the services of the senior lieutenant-commander available for this command.

By a readjustment of the unequal distribution of lieutenant-commanders, as shown above, it would be possible to provide each ship in the fleet with a lieutenant-commander who, according to the practice of five years ago, would have had sufficient rank to be executive officer; and who, according to the practice of to-day, would certainly have rank and experience enough for the command proposed for him.

There are few, if any, first lieutenants to-day who are satisfied with their jobs, which is very conclusive evidence that there must be something the matter with the job. There are few, if any, senior engineer officers who are not satisfied with their jobs, which would seem to indicate that there is nothing the matter with the job. The remedy for the existing state of affairs would seem to be to establish the senior lieutenant-commander available as the head of the "gunnery department," with a status similar to that of the senior engineer officer in regard to the engineering department.

The one primary duty of every officer on board should be in connection with preparation for battle. All other duties are secondary to this, and if it is logical to establish a form of organization which provides for this in the engineer's department, it is logical to provide a similar organization in the other branch of

the line. We have in the past been unduly sensitive in regard to care and preservation of ships, and entirely too much importance has been given to this question in our regulations. It is now apparent that the life of our hulls is much longer than the life of the ship as an effective fighting unit.

Aside from the confusing situation produced, it is entirely illogical to take the senior officer on board, after the executive officer, and fail to utilize his training and experience in connection with battle training—which is precisely what we do when we establish a first lieutenant and make him responsible primarily for the condition of paint work. If the name "engineering department" is an appropriate designation for the department primarily responsible for the efficiency of the motive machinery, it is submitted that the name "gunnery department" is equally appropriate for that branch of the personnel primarily responsible for the effectiveness of the offensive power of the ship.

As to the proper employment of the present ordnance officer—who is at present, on board the majority of ships, a lieutenant well below the rank appropriate for a head of a department—it would seem to be proper to make him the assistant to the head of the department for the purpose, primarily, of relieving him of the details in connection with responsibility for matériel, and of assisting him in the routine administration of his department.

There is no reason whatever for requiring a separate officer as a representative of each of the matériel bureaus. There is, on the contrary, very considerable conflict and confusion resultant from this practice, and a general tendency to produce an organization built around bureau cognizance.

The establishment of a general storekeeper responsible for all Title Y stores, and all Title B stores not issued for use, has been entirely satisfactory. The establishment, in a ship's administrative department, of responsibility for all stores issued for use, and all bureau allotments, in the hands of one officer, will be equally satisfactory, and this duty is appropriate to the assistant to the head of the gunnery department.

The establishment of the responsibility of this officer, as outlined above, would virtually make him the inspecting officer of the part of the ship cared for by the gunnery department. He should have no authority independent of the head of departments, and

should not have the authority to issue orders to men not placed under his orders for administrative purposes, except when carrying out the orders of his immediate superior.

THE SENIOR ENGINEER OFFICER.

The senior engineer officer is the only line officer whose status as "head of department" is fixed. He commands the engineer's department, and is responsible for the activities of the men under his orders in all that they do, except when they are specifically detailed for duty with another department.

This condition has been forced by necessity, rather than being the result of design. The engineer's force, when established as an integral part of the complement, had no traditions to upset. An organization suited to the requirements was developed, and no material changes in the form of the organization have been found necessary.

In view of the necessity of maintaining the efficiency of the personnel and matériel *at all times*, the control of the senior engineer officer over his men *at all times* was imperative. Any system similar to that at present established on deck, where the crew becomes active in gunnery exercises periodically, would have broken down completely.

Much can be learned by a study of conditions existing in the engineer's department.

THE NAVIGATOR.

The navigator has, at present, no status in the organization. His duties are primarily of an advisory character, and he is the only officer on board who has responsibility independent of the executive officer, reporting direct to the captain in matters of navigation. For administrative purposes he is subordinate to the executive officer.

He should be made responsible for the training of all men required for ship-handling purposes; and in order to make this practicable, he should control all men required for helmsmen, signalmen, and the transmission of radio messages. At present he does not control anybody. His own immediate subordinates are usually placed under the command of some other officer.

THE DIVISION OFFICER.

To establish and maintain discipline there must be personal contact between the superior and the inferior, and as one man can influence only a limited number of his fellow men, it follows that the size of the units that compose a fighting mass must have some relation to the numbers of inferiors of average attainments that can be influenced by one superior.—*Précis of Modern Tactics.*—PRATT.

One of the main props of this edifice, built up of obedience and confidence, is the Company Chief. On him falls the labor of training and instructing the soldiers.—BOGUSLAWSKI.

The most efficient armies are those in which the Captains are given the greatest latitude in the methods of instructing and providing for their companies, and held to the most rigid accountability for their good condition and military efficiency.—WAGNER.

The position of the division officer of our organization, in relation to the men of his division, should be precisely the same as that indicated in the above quotations, between a company commander and his men.

The division should be the basic unit of our organization. This condition does not exist to-day. The division has forced itself to the front, as the only real unit which we have; and we have made fitful attempts to recognize the responsibility of the division officer. We have, however, failed absolutely to make it possible for the division officer to exercise that complete control over his men which should be the foundation of our discipline. We have failed to remove the forces, strong in the traditions of a hundred years, which attack the division from the flank and destroy it as an effective and cohesive unit.

Strongest among these forces is that of the boatswain. This officer, who at one time was in unquestioned control of the deck force, has carried along through all these years the traditional conception of his duties, and we find him to-day exercising, independent of the division officer, the same control over that part of the personnel which forms around the boatswain's mate as a nucleus, which he exercised before the division was established as an administrative unit.

He works from stem to stern, supervising the work at the forward division with the anchor gear, the after division with the towing gear, and amidships he takes complete charge of the hoisting of boats.

In mooring ship alongside a dock, he assumes the power of

issuing orders to the men of divisions direct—often regardless of the presence of the division officer.

There is no attempt to suggest that this officer is not as a rule a most useful, energetic, and forceful person. It is suggested, however, that there is no place for him in a modern organization, and that his presence on board is destructive to the initiative of the division commander.

The fact that there is often found so little proficiency in seamanship, on the part of our junior officers and most of our enlisted men, is due largely to the fact that we have specialized in knowledge, and concentrated that knowledge in the person of the boatswain and his gang.

What is usually known as a division is that part of the organization which works on deck under the boatswain; the remaining members retiring within a turret, or some other secluded spot, and serving as strikers to one of the specialists who make up the nominal strength of a division.

Next after the boatswain, the most destructive influence is that of the master-at-arms. Independent of control by the division officer—independent in fact of any effective control—he exercises supervision over the conduct of the men of the division at all times.

A division officer commands his division at general quarters. He cannot be said to command it at any other time, and in failing to establish a condition by which his command is complete we fail to take advantage of the opportunities of daily life to educate our officers to exercise command, and to establish that relation between the division commander and his men which is the keynote of effective discipline.

The development of naval gunnery which began shortly after the Spanish War, and which has continued up to the recent past, was the triumph of the division officer. The remarkable improvement was made possible by a system which stimulated the interest of the division officer, established his responsibility for results, and left him absolutely free to develop methods for producing results.

In order to accomplish this result, it was necessary to disrupt our organization. Nothing was allowed to interfere with the division officer. and the division officer having no part in anything except gunnery training, other things suffered. The forces

responsible for discipline and ship cleaning, for the time being, were held in restraint, with the result that there was during the progress of gunnery a marked deterioration in every other field. We have of late been attempting to regain what was lost, and in doing so it is a question as to whether or not we have stopped progress in gunnery.

We shall never be able to proceed on a rational line of improvement, until we have established an organization in which the interest of the division officer is enlisted in the development of the division in all the elements which go to make up its efficiency as a whole.

Whatever the immediate effect produced by the removal of elements upon which we have become accustomed to depend, it is imperative, if we are to establish the division officer in command of his division, that we remove the forces which interfere with establishing of that condition.

In establishing the division as an administrative unit, we should try to get a clearer conception than we have at present, as to what a division is. The word has been used indiscriminately to describe any kind of unit. We have divisions varying from 8 men to 250 men.

A division should be recognized as a unit having an average strength of about 70 men, proper for the command of a lieutenant, and composed of men who naturally group themselves together, because of a similarity of duties. The test of the grouping into any unit should be the purpose for which the men are put on board. Men placed on board to man guns naturally form gun divisions. Men placed on board to man fire-rooms naturally form fire-room divisions. Here the administrative unit is the same as the battle unit. Men placed on board for the performance of duties not specifically connected with battle cannot be grouped by battle stations, because they will gravitate back into units commanded by the officers and petty officers who supervise their daily work.

The powder division, a monstrosity of organization, represents an unscientific attempt to group men in no way connected by a similarity of duties into a battle unit. The powder division is an organization in name only, and we usually find the men composing it acting in self-formed units under the officers responsible for the work for which they were put on board ship.

The ideal condition, of course, would be to establish complete control by the gun-division officers over all men upon whom they depend in battle. This condition is impossible without a large increase of complements. Any attempts to put servants, landsmen and yeomen in gun divisions would fail, because they would not stay there, and we would have a large number of men under no control. Men put on board ship for special purposes can be handled effectively, from the administrative standpoint, only by organizing them into units the character of which is established by a similarity of duties.

It is necessary to utilize these men in battle, and in order to do this, they must be detailed for the purpose; although an attempt should be made to preserve, as far as possible, the integrity of administrative units, in order that men accustomed to each other, by daily association, may work together at battle stations.

WARRANT OFFICERS.

In attempting to establish the status of warrant officers in the modern organization, we have to overcome the forces of tradition. The present regulations in regard to warrant officers have been handed down from a time when they were the actual heads of the only departments which existed aboard ship.

With the establishing of the division as the administrative unit, and the insistence on the qualification of the enlisted men for the primary duties for which they are put on board, we shall arrive at a condition where we can depend upon the division to handle practically all the work on board, and the necessity for the various groups of specialists will largely disappear. It is doubtful if a place can be found for the boatswain in an organization founded on the division as the basic unit.

The remaining warrant officers, the gunner, the electrical gunner, and the carpenter. are easily placed in charge of the small groups of artificers who will be necessary to undertake repairs beyond the capacity of the gun divisions, and as assistants to the matériel officer in accounting for the matériel for which he is responsible. and in inspections of the parts of the ship for which the gunnery department is responsible.

ENLISTED PERSONNEL.

The present condition of the enlisted personnel is chaotic. We have a multiplicity of rates and titles. All of our titles suggest the performance of some particular duty rather than the rank and authority of the holder in a military organization. The present situation is the result of the forces of a misdirected conservatism which has retained in the service a type of petty officers developed in the past, while at the same time a new type of petty officers has been developed to meet the necessities of modern conditions. We have at present, generally speaking, two sets of petty officers, and many specialists who are petty officers for the performance of special duties only.

There appeared in the pages of the PROCEEDINGS of the Naval Institute, immediately after the Spanish War, an extended discussion of the methods to be employed in training our enlisted men. There were several dissenting opinions expressed, but generally the weight of opinions of the officers who took part in that discussion was in favor of the retention of the sailing ship, and in favor of educating the topman for service in modern ships.

Since that date two facts have become evident, and are not believed to be open to serious discussion: *First*, that it is entirely impracticable to produce the topman of former days; *Second*, that we would not do it if we could, since the type of man produced is entirely unsuited to our requirements. It seems to have been the opinion of a number of officers who took part in this discussion that the form of training proposed was necessary to develop the character and courage required.

Character and courage are attributes which are widely distributed among many classes of men. Courage is usually dependent upon familiarity with environment—a topman would probably have been very badly scared in the engine room of a reciprocating destroyer. The evidence accumulated during the past years, from experience in accidents of various kinds incident to life in the modern navy, has amply demonstrated that the fears expressed as to the deterioration in character, due to the lack of training in sailing ships, were not well founded.

All this might be considered to be a dead issue, but it is believed that the opinions expressed at the time represented a sentiment which has had a powerful effect in retarding the development

of the personnel to meet modern conditions. The old ratings have been retained, with very much the same qualifications for advancement as in former days.

Boatswain's mates and coxswains are very much the same as formerly, except that their opportunity for learning seamanship has been destroyed. Prevented by a misleading title, and the traditions surrounding that title, from adopting a helpful mental attitude towards their real duty on board ship, they have never developed into really useful battery petty officers.

It is an astonishing fact that no where can there be found anything in the way of instructions as to just what the qualifications for a boatswain's mate are. It is understood, in a general way, that he must be a seaman; but just what this means is left to the individual judgment of the officer making the appointment.

The qualifications for turret captains, electricians, water tenders, hospital apprentices, and others, are established in great detail.

A boatswain's mate might be entirely competent in masting vessels, and yet be entirely ignorant of the simplest fact in regard to the machinery of the turret which he is required to man in battle. He is the petty officer most concerned in handling men, which he does in connection with the ordinary work around the decks. This cannot but impress the mind of the recruit with the idea that scrubbing decks, and not gunnery, is the really important function aboard ship.

In the meanwhile a new type of petty officer has appeared in the organization, forced by the actual necessities of modern conditions. The most forceful and capable petty officers we have to-day are the turret captains. It would be most unfortunate if this were not the case, for not only do they perform duties requiring the highest order of resourcefulness and initiative, but conditions may arise which, if we exist for war, would render failure on their part a serious matter indeed.

They are junior to all petty officers of the line with whom they come into contact, and while the instructions contained in the "ship and gun drills" establish their command as absolute within their turrets, we do not use them as petty officers until they go to their battle stations, when they find themselves in command, not only of men to whom they have not been accustomed by daily association, but actually of men who, up to that time, have been their

seniors in the division. Could any absurdity be carried further in a military organization?*

On top of this organization, confusing enough in itself, we have the master-at-arms.

The influence of the masters-at-arms on the morale of the line petty officers is destructive. Uncertain as to their status in regard to them, the other petty officers usually withdraw from participation in the enforcement of discipline, and devote their attention to the performance of their own special duties.

The masters-at-arms, clothed with great powers, beset with more than ordinary temptations, independent of any effective control, usually develop along lines familiar to investigators of conditions in the police force of our municipalities.

From the standpoint of battle efficiency there can be no argument but that improvement would result from the establishment of one branch of line petty officers, whose primary qualifications should be based on their ability to perform the necessary duties in fighting the ship. The only question upon which argument is possible is the question as to whether or not we are able to insist on the necessary qualification in elementary seamanship, on the part of our battery petty officers, to enable us to dispense with a special branch of seamanship petty officers.

This question will be answered in the affirmative by any officer who has had experience with gunner's mates in destroyers. As a plain statement of fact, our gunnery petty officers know about as much seamanship now as the seaman petty officers. The 7-inch battery of the *Connecticut* was recently dismounted, and landed by the gunner's mates, under the gunner—a very creditable performance in modern seamanship.

Whether we admit it or not, seamanship is at present a specialty. We have a few men who can steer, a few who are good leadsmen, and a few who can handle boats. Whenever we want men for special duty it is necessary to train them for that duty, and we

* A change has been made in the Navy Regulations, 1913, in the relative rank of turret captain, first class, and gunner's mate, first class. The order of rank is as follows:

Chief petty officers: Chief master-at-arms; chief boatswain's mate; chief gunner's mate; chief turret captain.

Petty officers, first class: Master-at-arms, first class; boatswain's mate, first class; turret captain, first class; gunner's mate, first class.

are quite satisfied if we can provide men sufficient for that duty, and do not attempt to train the whole crew. It would be no more practicable to train all seamen to be good helmsmen than it would to train them to stand a dynamo-room watch, and there is no necessity for us to attempt it. The men of a quarterdeck division of a battleship would be relatively helpless on the forecastle, until they had been trained to the duties required on the forecastle.

An elementary knowledge of marlin-spike seamanship is of course essential to all men who work on deck, but the amount of knowledge required is small, as compared with former times, and is easily within the capacity of a man of sufficient intelligence to perform the duties required in connection with the battery.

It is a strange fact that while we are dependent, on battleships, on boatswain's mates and master-at-arms, the duty of both can be performed by a gunner's mate on a destroyer, without in the least interfering with his usefulness as a torpedo man.

Coxswains are supposed to handle boats, but when we want a steam-launch coxwain we are forced to train him. It would be just as easy to train a gunner's mate as to train a coxswain.

The principal improvement which would result from establishing qualifications for petty officers based upon their ability to perform the primary duties for which they are placed on board ship would be, not the direct improvement from the standpoint of battle efficiency, however great that improvement might be, but the improvement which would result from the establishment of a homogeneous and cohesive organization, in which it would be possible to use all petty officers for their most important duty aboard ship—the control of men—and the improvement due to breaking up the numerous "gangs" and details which have grown around ratings and titles implying limited and restricted usefulness, and which have prevented the establishment of the division as an effective administrative unit.

The engineer's force has always been in a very much better position in regard to petty officers than the deck force, but here also we find the same misuse of title. We have water tenders who cannot be separated from tending water. We have oilers bound forever, by the possession of a degrading and disgusting title, to the duty of oiling. Many a promising recruit has been prevented from enlisting in a branch which offers excellent opportunities for advancement, by the title of coal-passer.

It is perfectly possible, and perfectly logical, to develop a type of petty officer in the engineer's department who should be capable of all the duties in connection with the care and operation of marine machinery, both in the fire rooms and in the engine room.

There is nothing in the training of a shop machinist which qualifies him for a petty officer; and many of them, enlisted with this qualification, fail as petty officers. The work required of a watch-standing petty officer is work which can be learned only aboard ship. The navy to-day is full of chief machinists' mates who have, without encouragement, qualified for their ratings, passing through all the grades from coal passer up; while there are also many chief machinists' mates, of a high order of skill, who have never developed into really satisfactory petty officers.

Our water tenders, who are first class petty officers, should be as capable, in handling an engine room watch, as the average machinist mate, first class, and would be if we were not prevented from using them by the restrictions of a title which binds them to the fire-room forever. The amount of work requiring more skill than is possessed by the average bench hand who can be developed aboard ship is very small, and the training required for this work could readily be imparted in the trade schools to the small number of men required, who have already qualified as watch-standing petty officers.

The definite steps necessary to bring about the desired results are as follows:

First: Abolish all titles as they exist to-day in the line branches.

Second: Reestablish, for each branch which requires special training—signals and ship handling, battery, and engineering—one line of petty officers, to be called chief petty officers, petty officers first class, petty officers second class, and petty officers third class.

Third: Establish a qualification for each branch which would fit men of that branch primarily for the duty for which they are placed on board.

Fourth: Abolish entirely the present illogical schedule of extra pay, and establish a system of extra compensation, for special qualification, based on modern conditions. Develop the trade schools for the purpose of giving the special training required.

Fifth: Reclassify, in accordance with naval practice, the trades represented on board ship, and establish the rates of chief arti-

ficer, artificer first class, artificer second class, and artificer third class, for men who are not petty officers, but who require a special training in trades.

Three branches of the line for which a distinctive qualification would be required would be as follows:

SIGNALS AND SHIP HANDLING BRANCH.

Primary Qualifications.—Ability to command men. Proficiency as helmsmen, as leadsmen, and in signaling. Men of lower ratings detailed to this branch to be considered in training for the higher rates. Coxswains of all power-boats to belong to this branch.

Extra compensation for qualification in elementary navigation. Chief petty officers, so qualified, to be eligible for command of tugs and for warrant rank.

GUNNERY BRANCH.

Primary Qualifications.—Ability to command men, and to perform all the necessary duties in connection with the care, operation, and overhaul of the ordnance equipment.

Extra compensation for qualification in mechanical skill sufficient to undertake repairs.

Torpedo men to be detailed from above.

Men specially qualified to be eligible for warrant rank.

ENGINEERING BRANCH.

Primary Qualifications.—Ability to command men, and to perform all necessary duties in connection with the care, operation, and overhaul of marine machinery.

Extra compensation for mechanical skill necessary to perform any work required aboard ship.

The training for this should be limited to the attempt to produce good bench hands.

Men for machine tool hands should be artificers. Not more than four would be required on a battleship, and they should be employed continuously at this work.

Men specially qualified to be eligible for warrant rank.

FORM OF ORGANIZATION PROPOSED.

It is assumed that no exception can be taken to the statement that the form of organization best suited to our requirements is the military organization.

A military organization is one based on complete control of men by leaders responsible for them under all conditions; and the establishment of direct lines of authority by which the orders of the commander may be, with certainty, transmitted to the lowest units composing the organization as a whole; an organization in which the control of men, by their own leaders, is so complete that no disorganization can result when, owing to the accidents of battle, the leaders must act on their own initiative.

It might be argued that we have such an organization, at present, for battle stations. This is but partially true, but, admitting the complete correctness of this statement, we are forced to admit that this is an organization which disappears with the retreat from drill, when we go back to an entirely different form of organization which is not military, and in which we fail to avail ourselves, in the daily administrative work, of the opportunity of training our men to work under the leaders who must command them in battle.

There has been a general tendency of late in the industrial world, to work away from the military idea, and to adopt a form of organization based on functional control; an organization in which the activities of the men are controlled at one time by one specialist, and at another time by a different specialist; an organization in which supervision is established over the act which the man is performing, rather than over the man himself. This form of organization is workable only where it is possible to plan long in advance, and where no unforseen emergencies are to be expected. This kind of organization approximates to that which we have to-day aboard ship, except that in our case it is the result of accidental development rather than design.

It is not possible for us to adopt anything in the way of organization as simple as that of a regiment.

In the first place we have aboard ship three branches in the line which require special training as different as that of the branches in the line of the army. Whereas a regiment is an incomplete unit, depending for its existence upon other special

corps, we have aboard ship representatives of all of the branches which are necessary to form a completely self-supporting whole.

We are moreover under the necessity of fitting our organization to the ship, and, owing to the varying conditions to be met, are forced to establish organizations to meet the several different conditions. If we are able to adopt one organization to meet the several different conditions, we can at least insure that each of our organizations shall be military, and adopt the broad general principle that *as far as practicable* all men shall be employed at all times under the leaders who command them in battle. We must recognize the fact that the one primary duty for which we exist is to fight the ship in battle, and that all other duties are secondary and relatively unimportant.

The form of organization proposed is shown on the accompanying chart. This organization has been worked out for the present complement of a ship of the *Connecticut* class, and is submitted as one which can be adopted without the comprehensive changes in enlisted personnel which have been recommended. No material difference in form would result from these changes.

The organization shown is an administrative organization, the only form of organization which will hold together under the stress of the day's work. Any attempt to base an organization on battle stations alone will fail, because it will be found to be impracticable to hold together a loosely joined battle unit, similar to the present powder division, which is composed of men who normally work together as part of some other unit.

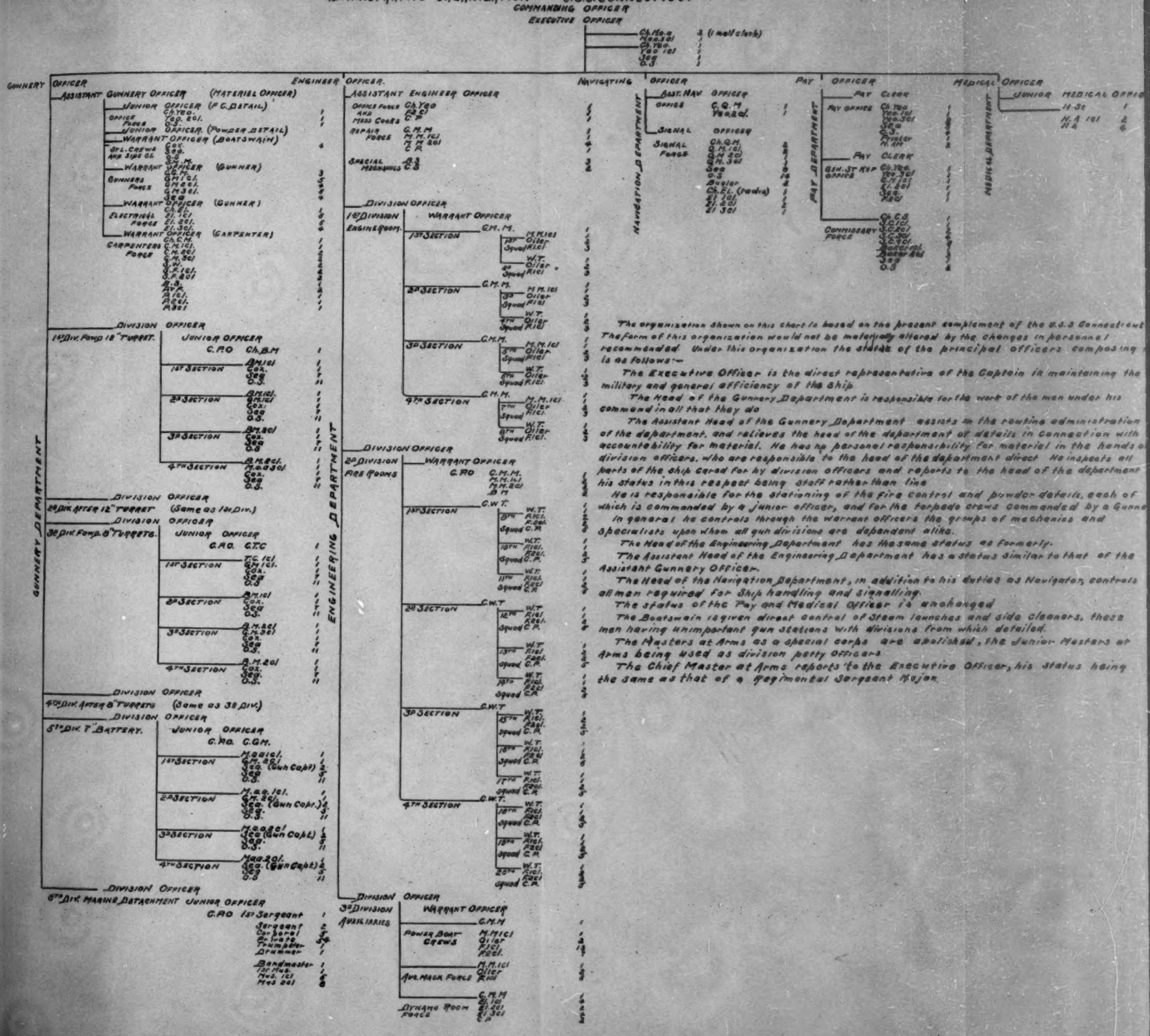
It will be noted that the organization of the engineer's department is carried out to the squad, whose identity is retained under all circumstances. This is made possible by the fact that there are at present available in this department a proper number of petty officers with rates appropriate for this duty. With a readjustment of ratings in the present deck force, the squad organization would be equally appropriate.

The general scheme of organization is based on the division of the personnel between five co-ordinate departments and the sub-division of the departments into units, the character of which is determined by the particular requirements of each department. No attempt has been made to divide the pay department into four parts because that sub-division happens to be appropriate for a gun division.

The executive control by the heads of departments should be complete over all men of their departments. The executive officer will then be free to execute his proper functions as an aid to the commanding officer in co-ordinating the departments, and in inspecting them as to their efficiency in accomplishing the required results. The present organization is not satisfactory. In the hands of capable administrators it has yielded good results; but at the expense of an enormous energy, wasted internally on the organization, which, under a better organization, might have been expended externally upon results for the accomplishment of which the organization exists.

The most important result, however, from an organization based upon the retention of centralized control and decentralization of detailed activity, will be the establishment of a condition by which the officers will not be denied the training in administrative work necessary to fit them for positions of responsibility which they must later fill.

ADMINISTRATIVE ORGANIZATION U.S.S. CONNECTICUT



The organization shown on this chart is based on the present complement of the U.S.S. Connecticut. The form of this organization would not be materially altered by the changes in personnel recommended. Under this organization the status of the principal officers composing it is as follows:—

The Executive Officer is the direct representative of the Captain in maintaining the military and general efficiency of the Ship.

The Head of the Gunnery Department is responsible for the work of the men under his command in all that they do.

The Assistant Head of the Gunnery Department assists in the routine administration of the department, and relieves the head of the department of details in connection with accountability for material. He has no personal responsibility for material in the hands of division officers, who are responsible to the head of the department direct. He inspects all parts of the ship cared for by division officers and reports to the head of the department his status in this respect being staff rather than line.

He is responsible for the stationing of the fire control and powder details, each of which is commanded by a junior officer, and for the torpedo crews commanded by a Gunner.

In general he controls through the warrant officers the groups of mechanics and specialists upon whom all gun divisions are dependent alike.

The Head of the Engineering Department has the same status as formerly.

The Assistant Head of the Engineering Department has a status similar to that of the Assistant Gunnery Officer.

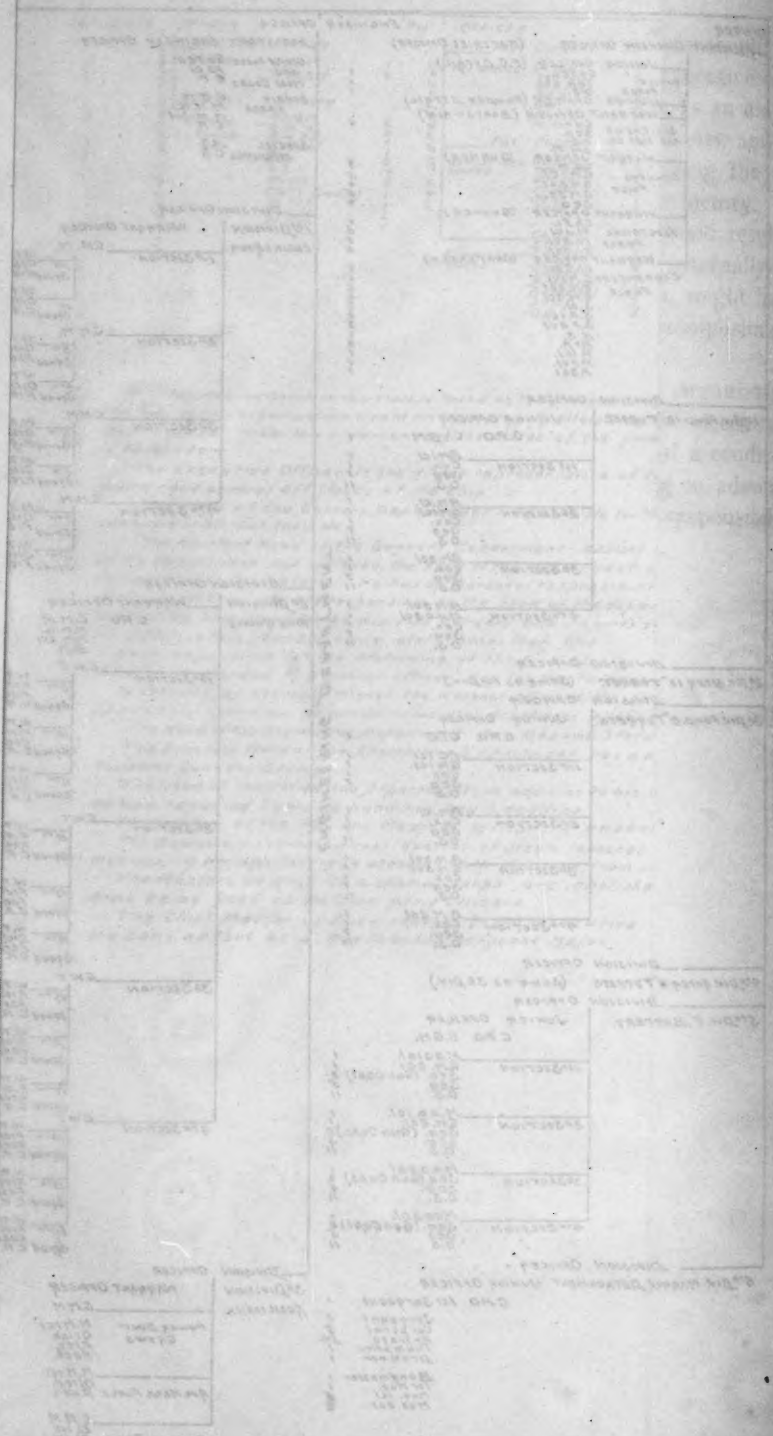
The Head of the Navigation Department, in addition to his duties as Navigator, controls all men required for Ship handling and Signalling.

The status of the Pay and Medical Officer is unchanged.

The Boatswain is given direct control of Steam launches and side cleaners, these men having unimportant gun stations with divisions from which detailed.

The Masters at Arms as a special corps are abolished, the Junior Masters at Arms being used as division petty officers.

The Chief Master at Arms reports to the Executive Officer, his status being the same as that of a Regimental Sergeant Major.



DISCUSSION.

Organization of the Ship.

COMMANDER A. B. HOFF, U. S. Navy.—The terrible conditions disclosed by the writer may well make the service sit up and gasp. With the exception of his timely and interesting remarks on "Enlisted Personnel" (which remarks, by the way, have nothing to do with the title of the essay), chaos reigns supreme. What is the answer? Is the essayist right?—right in his diagnosis, right in his cure? Personally I say, "No."

I believe him to be reasoning from "imperfect generalization."

Nor, personally have I ever been shipmates with, or heard of, three-quarters of the troubles he enumerates. I believe that a close analysis of the facts presented will show that nine-tenths of the troubles the essayist has had are not those of organization, but of administration. Where they exist, it is undoubtedly due to the fault of the executive officer.

I except the removal of marines from ships of the fleet, and the abolition of the *rate* (not duties) of master-at-arms. These two steps would, I believe, increase the efficiency of any administration.

In reading over the essay it had at first been my intention to break a lance with my gallant adversary every time our opinions differed. For example, with regard to the abolition of the boatswain (one of the most valuable officers in the ship), or the complaint about the use of the well-understood word "department" (meaning the collection of duties assigned to any one). The differences rapidly became so many, however, that I am fain, now, to restrict myself to what I believe to be two of the main issues of the essay, showing: First, that the organization of the Engineer's Department is not suited to the "organization of the ship"; second, that the present organization is in all respects a proper one, based on sound principles. (Observe that it is not called the "best.")

ORGANIZATION PROPOSED BY THE ESSAYIST.

The Engineer's Department on board ship is a *motive-power factory*. This is all it is—a motive-power factory contained within the unit of the fleet known as a "ship." It is the horse-team of the field-battery. The "hands" go to work in the same place every day, under the same bosses, following the same directing force from above. Sometimes a hand is cleaning a station, sometimes repairing it, sometimes operating it. But it is always the same station, practically speaking. When their spell of work is over they wash up and go back home to the ship, just the same as any other factory hands do. A factory organization is the one necessary here, and such a one has been ably worked out by the essayist during his long career as an engineer officer. No one commands greater attention on the part of his hearers than himself, on this subject.

Now is this organization suited to the ship? Plainly not. For the ship is not a factory, but a collection of factories—factories where the same hands are employed in doing entirely different work at different times. It is the scene of many activities, and it is also the home and recreation park of the people who live in it.

If the crew had only one thing to do, like the Engineer's, Pay-officer's, and Medical Department hands, then a similar organization to theirs would be possible. But they haven't. They have battle by day, battle by night, mine-laying, cruising alone and in company, gymnastic exercise, cleaning ship, boat drill, fueling ship, landing party, field-gun exercise, etc. They have all these things to produce. In each one they are organized on factory lines.

Now, if we had one lot of men for battle, another for cleaning, another for boats, another for landing party, etc., then each crew could be organized just as the Engineer's Department is organized.

In this case, when the captain wanted a certain thing produced he would simply call on the factory producing that thing—battle, boats, infantry, or what not. Each crew would work under the same people all the time, and produce *one thing*. They would then most properly and efficiently be organized on factory lines.

It is obvious that this impracticable. How has the essayist worked it out?

He presents a table with the gunnery officer in charge of what is called the Gunnery Department, and all duties are clearly defined. I will not take the space to repeat them, but ask you to note the incongruous duties of the assistant to the gunnery officer, and the sticking in of an extra cog in the machinery of execution of the captain's orders, namely, a gunnery officer.

How this is going to right matters of mal-administration is not clear. What points of excellence over the present system it possesses are not disclosed. In what particulars, duties that exist and must be performed are facilitated in their working, has not been told us.

In his table, the essayist indicates that division officers are the administrative heads of their divisions. This, of course, is not organization but administration. Since 1905, when the new Gunnery Drill Book came out, every ship I am acquainted with (and I have in my possession the organizations of 18 armored ships) is organized on these lines. Their proper administration is another matter.

Personally I have the strongest convictions on this subject, and cannot conceive of a *ship* station bill dealing with a smaller unit than the division (or in some cases the group). I believe this ought to be a departmental regulation. All details are matters for divisional concern only; they are not the province of the executive officer.

I am convinced that, in analyzing the subject of his essay, the essayist has been also led into false deductions by his consideration of a ship's company as a number of men doing separate and parallel duties, whereas the truth is that ship organization deals with a number of men *inhabiting* a ship for *a certain purpose*. The purpose is not, to my mind, that indicated by the essayist.

On page 573, line 20, he states that he bases *his* organization on the daily administration of ship's business. I do not believe this will appeal to the

majority of officers in the navy. Organization on board ship should be based primarily on battle stations, and the administration of the daily routine should be developed from that. This presents no difficulties to those trained on the bridge in the fleet.

PRESENT ORGANIZATION IS LOGICAL.

It has been pointed out that the ship is a collection of factories, as far as the work produced is concerned. Now the organization of each of these factories (station bills) is perfectly capable of being "charted." In each chart not *all* the officers and men of the ship are always included, nor is it necessary they should be. There is no earthly necessity that the gunnery officer or first lieutenant should be charted in organizational administration measures when these measures do not include their functions, nor indicate their special employment otherwise. Every time something is produced on board ship, it does not necessarily take all hands. But each chart by itself is a complete organization, and the interrelation of each person should be perfect. These station bills are the ship's organization. The instructions for their proper development is the ship's administration. It is in the second of these that I claim the essayist is locating his troubles, by applying a cure to the first. This cure I do not believe to be efficacious, even for the first.

But as to the present organization being a logical one upon which to base a capable administration of affairs on board ship:

A crew has various duties to perform. Each must have its "specialty nucleus." Each must have its supervisor with a staff, great or small, to provide a point of support for the "general worker"—*i. e.*, the deck hand who has to turn his hand to many different things. Examples of this supervision are:

Ship control	Captain.
Ship administration	Executive.
Ship cleaning	Senior engineer.
	First lieutenant.
	Medical officer.
	Pay officers.
Gunnery training	Gunnery officer.

Some officers will supervise one specialty, as well as direct others. As, for example, the captain. Each has his assistants, special as well as general. The general assistants are the division officers, with their subordinates. These should, and do, in all ships that I am acquainted with, have supervision, in divisional matters, over all members of their divisions doing divisional work, and over specialists temporarily working under them. This last is administration, pure and simple.

This is the system that we have to-day, and is the only basic system that will fulfil the requirements. The factory system, in which everything goes on the same from day to day, will not do for the conditions as they are, for the reasons cited above.

Now suppose that the Engineer's Department were confronted with the problem of general worker, instead of having all the machines in its factory constantly manned. Suppose that the senior engineer officer had only one-fourth of the complement necessary to do *all* his work (as is the case on deck). How would he work out his problem?

There is only one way he could do it, and that is by the system as it is worked out "on deck." (The facts of the following are absurd, but not the logic.)

If he wished to "man" his fire-rooms, he would have to have his men stationed for "Fire-Room Exercise," to do all the necessary things *there*. For the engine-room, these same men would have to be stationed in an "Engine-Room Bill"; for the "Auxiliary Station," in another bill; and so on.

For each separate activity of his force he would have to have a specialty nucleus—an officer supervising, and a nucleus of specialists as a point of support for the division officer and his division of general workers when they engaged in the different kinds of work.

The basis of his bill would be "steaming efficiency," not "the day's routine," just as the basis of *ship organization* is battle, not the "day's work."

In other words, the factory system is good only where the same thing is produced daily in repetition. These are the conditions in the Engineer Department of any ship. They are not the conditions "on deck."

By the way, what has become of the officer of the deck in the essay?

THE PRESENT SHIP ORGANIZATION IN THE NAVY.

(Based on the *Michigan's* system.)

CAPTAIN	EXECUTIVE	Officer of the Deck.	I. Gun Division.
I	I		II. "
Captain's Office	Executive's Office		III. "
			IV. "
			V. "
			VI. "
			VII. (Marines.)
			Engineer Department.
			First Lieutenant's Department.
			Navigator's Department.
			Gunnery Officer's Department.
			Medical Department.
			Commissary Department.
			Storekeeper's Department.
			Pay Department.
			Chaplain's Department.

This is the basic organization *for* administration. The administrative measures necessary for this organization are embodied in a series of station bills, Ship's Regulations, and Ship's Instructions.

The station bills are truly organization also, but are not the basic organization. Each of the above departments has its place in battle.

COMMANDER W. W. PHELPS, U. S. Navy.—The navy has been in a period of transition since the *Chicago* was appropriated for in 1883, thirty years ago. In the exact middle of that period, the shock of an amazingly successful war entered the wedge of military reformation, and we had the amalgamation law of 1899. This last half of the thirty-year period is a period long enough to justify a look as to how far amalgamation has established itself as having been a thoroughly sound military measure. Everyone testifies that our wonderful results in engineering have been directly due to amalgamation, and the consequent growth of the now very nearly military system pervading the engineer departments of our ships—a system more nearly truly military than the systems pervading the other departments of the ship.

It is further testified to in this instance: Commander Procter is an "amalgamated" officer; and here we have the result of his broad training—training in command, as a chief engineer, and as an executive, having given him the military penetration to develop the first ship organization along military lines, and from a military point of view, that has been published to the service. Thus he is distinguished as more progressive and more of a "military" officer than many of us whose training has been solely along the narrow lines of a "deck officer"—not broad enough to have trained us to be able to solve this knotty problem of modern ship organization. It would appear that there could be no clearer demonstration of the *military value of amalgamation*, as applied to personnel.

For an illustration of its value as affecting material achievements: It is a matter of record that one of our scouts (under Commander Chandler) retubed her boilers with her own force, astonishingly cheaper and astonishingly quicker than by the yard estimates of cost and time. This seems to be ample proof that the man-o'-war's man, under military influences, improves in all his standards, even to the extent of his industrial output. This sort of material achievement is, to the navy, a military achievement of the highest order; and it is directly due to the military system in ships' engineer departments, and that is the direct result of the amalgamation law.

With these illustrations of the dual effect of amalgamation—on personnel, resulting in broader and greater military ability; on matériel, resulting in a higher standard of material achievement—it would surely seem time to unite with the essayist in an earnest hope that administrative steps may be taken to amalgamate some of the related ratings on board ship.

But the complete value of amalgamation will not be gained unless we also amalgamate *ship's work* with *military duties*, whereby we will get what, only, can be truly called *naval duties;* and this amalgamation is one of *spirit*, and can ensue only when we remove the marines from the complements (whereby we will thus take a further step in military amalgamation, by amalgamating the Marine Corps with itself and within itself); because the atmosphere around our men, and the mental attitude of our men, should at all times be such as to lead them to the point where they will come to recognize that they have higher duties and higher responsibilities than merely the successful accomplishment of a job of ship's work.

It would appear to be considered, by some, that those of us who are earnest about landing the marines would expect the man-o'-war's man to

be doing nothing but "Right face," "Left face." That is a misunderstanding. That would be but an empty form. It is not the form we seek, but the *substance* of the whole proposition. And the more of the "substance" we have, the less need there will come to be for the "form." In the end, the "substance" we all aim for is *military ship organization.*

COMMANDER R. R. BELKNAP, U. S. Navy.—A proposed improvement appeals more strongly when it stands on its own merit. Condemnation of what has gone before is apt to incite distrust. The *Navy Regulations* are misquoted in this article, an examination of every edition as far back as 1896 showing that two imputed "absurdities" do not exist.

Professional readers will object to the free use of the inclusive *we*—"We have nothing which can, with any propriety, be called an organization"; "we are involved in hopeless confusion"; "we have attempted" to produce station bills covering every man's duty "under every possible circumstance"; etc. Let him confess for himself, if he choose. There is no denying that there may have been instances of these faults; but the author makes out that they are common, and characteristic of all our ships' organizations. That this is not so is shown by the organizations of upwards of twenty large ships, which apply common-sense principles logically to the needs of a ship's whole duty. The author forgets, or perhaps does not know, that experts on organization have spoken highly of ours on board ship. Had the prevailing condition been hopeless confusion, they could not have failed to notice it. The charge as to station bills is equally baseless. For years ships' general bills have dealt with divisions, leaving details to the division bills, where they belong.

The author's ideas appear confused by a little knowledge of scientific management. He makes the mistake of starting with a predetermined system and trying to make the conditions meet it. That way to go about it is wrong, like most of his sweeping generalizations. The general idea of following a regimental organization is satisfactory, but its application must not be carried farther than appropriate to ship conditions. A battleship's organization must provide for all that a regimental organization does and much besides. On shore a company may be detached with but little effect on the rest of the regiment. Cut a whole gun division out of a ship, however, and the consequent readjustment is considerable.

The historical notes are interesting, but apparently they are drawn forth only to base a quarrel. He deplores the decline in seamanship, yet can find no place in his ideal organization for one whom he recognizes as valuable for seamanlike qualities, the boatswain. He regards him as a destructive force. Then he objects to the traditional use of the word "department." What harm if the sailmaker's mate does report his "department secure"? The meaning is clear.

The principal innovation in the *Connecticut's* organization is combining the gunnery officer and first lieutenant in one. This is unnecessary and inadvisable. It is true that the division officers must and should combine upkeep of ship and battery duties; but there is no difficulty in their being supervised by two officers, one for each function. The spheres are quite

distinct. The same men are not doing both at the same time. The executive is always there to prevent conflict, being responsible for all. Of course, where the first lieutenant and gunnery officer are ignored, either one would be dissatisfied with his job; but that is bad administration, not bad organization.

Efficiency does not mean that gunnery and cleanliness alternate in importance. The pressure would be greatest for both at the same time; and, under the tension of long-continued war conditions, if the gunnery officer must keep the ship clean and in good order and repair, as well as generally supervise the armament, he will break down, even if the ship does not. The idea that during the target-practice period cleanliness and order may go by the board, and the rest of the time gunnery may go, is long past. All this was well discussed in 1911, resulting in the first lieutenant as an established institution. In this we have but adopted the practice of the British, French, and Japanese navies, and have supplied a defect we have long felt ourselves. Can it be that all but the author are wrong?—that the organizations which we modestly thought gave efficient results were after all only absurdities? The new *Navy Regulations* give back to the gunnery officer all the authority he had before. As they are now, the regulations allow all the authority and all the latitude necessary to organize, and to administer, a ship efficiently.

There is something in the remarks on masters-at-arms, but the remedy lies largely in the hands of the ship's officers. There is nothing to prevent widening or limiting a master's-at-arms duties, nor to prevent holding other petty officers up to the military standard they should have.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NAVY SIGNAL SYSTEM.

By ENSIGN E. L. BARR, U. S. Navy.

INTRODUCTORY.

Signalling, according to the opinion of the Fire Control Board appointed December 14, 1909, and approved by the Secretary of the Navy, is one of the four essentials of a ship's battle efficiency. The signals are in a great measure confidential, and our books and methods are becoming more complicated every year. In spite of all, signalling is left very much to the individual ship's signal officer, which results in almost entire lack of system and consequent lack of efficiency in signalling throughout the fleet.

The army has a separate signal corps. It does not follow that the navy must have, but a separate signal branch would certainly result in much greater efficiency in signals.

FAULTS OF THE PRESENT SYSTEM.

There is no well established method of training for signalmen. At the Great Lakes Training Station, and at other stations where classes have been established, the men are chosen from volunteers, for the most part. Men who appear to be exceptionally bright are urged to go into the signal squad, but there is usually nothing compulsory about it. Once in a signal class, the recruit is left to the instruction of a chief petty officer, because the officer in charge of signals has too many other duties to give the class more than an occasional talk. Each chief petty officer has learned his own lessons under different officers and each will have a different method of teaching which is good or bad according to the ability and energy of the chief petty officer. System is entirely lacking in the method.

On board ship even a worse condition prevails. The signal officer is a junior ensign, often not a year out of the Academy, and sometimes he is given the detail because he had been found generally useless at other duties. That was well enough a few years ago, but with the present cry for speed, the officer of the deck has no time to look out for signals and it requires a good officer to handle them properly and promptly.

Even if the signal officer is efficient and energetic he is greatly handicapped by lack of the best personnel. The bridge requires exceptional men. The supply of such men is not great. Candidates for the signal force must be taken from the deck divisions and whenever there is an exceptional man on deck, who would make a good signalman, the division officer has noticed him and is not willing to let him go. For that reason the signal officer is compelled to take his men, men who will be called on for the most responsible duty in the ship, from a list of undesirable or mediocre men whom the division officer is willing to let go. These men are put on the bridge and left very much to their own resources. A new man is generally put recording or running messages. They are left to learn or not, just as they like. I have known men to be on the bridge for a year without learning to receive a message sent at ordinary speed in semaphore. Men whom a division officer is willing to let go are very apt to be of such a type.

Men who volunteer to go on the bridge seldom do so because they want to learn signals, but because they see a chance to get out of heavy work on deck. A man who wants to work and gain advancement can seldom be persuaded to take up signals, because it offers no opportunity for rapid advancement. It takes an average ordinary seaman about nine months to master semaphore and morse. When he has done that, if he has learned a proportionate amount about flag signals, he is qualified for signalman second class. It takes much longer to master the night systems than the day systems and few signalmen can be depended on to get a message by blinker in less than a year. An understanding of flag signals is much more slowly acquired, and a man is not a first-class signalman unless he understands flag signals and all the codes thoroughly, for he is liable to be called on in the absence of the signal officer or quartermaster, to read and answer complicated hoists. At the present time, I venture to say that not half the first-class signalmen in the fleet know what

"repeater" would be hoisted under a ship's call to request that a signal be repeated.

Signalmen are sent on the bridge away from the direct supervision of officers. They are too young to realize fully, the responsibilities of their position. When they have qualified as signalmen first class, most of them are not able to go farther. They are too valuable to be allowed to change to other rates and their training in signals has not fitted them for the duties of ship's quartermaster. Many of them have never heaved a lead, or taken the wheel. The few who are given a trial as ship's quartermaster, third class, have to learn an entirely new line of work and in doing so they forget much of what they have learned in signals. Those, who are not given a chance as quartermaster, stagnate on the bridge. There is nothing for them to work for. There are few restraints on them, and they quickly develop into regulation breakers. It is that which leads to the bridge force commonly being classified as the "pirates" of the ship.

At this time when so many changes are being made, signals should not be neglected. We are trying a new signal book, because we found trouble with the old one. Why not start at the bottom instead of cutting into the middle of the system with reforms? First, make good signalmen, then revise the book. Until we do have good signalmen we cannot have a good system of signals no matter what the book. Instead of having a small class at each station under an incompetent instructor, centralize the system.

A WAY TO IMPROVEMENT.

(a) Detail a lieutenant commander or lieutenant who has been flag lieutenant to the commander-in-chief or a division commander, as chief signal officer. Let him be stationed at Washington and make periodical visits of inspection to the different signal schools at the training stations. He should direct the instruction and training of all signalmen and all signal officers in the navy. He could make a homogeneous organization with one correct method instead of the present inefficient squads and eccentric methods.

(b) As aids to the chief signal officer, let an ensign or junior-lieutenant be sent to each training station where there is a signal class. These officers should be ones who have been successful signal officers afloat. They could be trusted to carry out the

program of the chief signal officer and arrange conditions at each station which would almost fulfill conditions afloat.

The men should be picked on enlistment for their general education, brightness, and penmanship. Put them in the signal class and give them such other training as the commandant of the station may think necessary. Let the signal officer pick out the undesirables by competitive drills and observation. He should have no other duties than the instruction of signalmen. Then he would give signals his entire attention, and the class would be well instructed in all methods of signalling instead of being sent to sea, with a superficial knowledge only, of hand-flag and night signals, and no knowledge of flag signals other than what the letters of the alphabet look like.

In order to overcome the reluctance of good men to taking up signals, and to provide a corps of well trained and efficient quartermasters, each ship of the fleet should have a signal force consisting of, a signal officer, a chief quartermaster (signals) and four signal watches, each watch being composed of:

(a) A signal quartermaster, third class, in charge of the watch.

(b) A signalman first class.

(c) A signalman second class.

(d) A seaman or ordinary seaman under instruction for recorder.

Make signals a distinct branch with the cross flags of the army for a specialty mark.

Give signalmen first and second class extra compensation as at present.

Create the rate of signal quartermaster and substitute crossed flags for the wheel of the present signal quartermaster, putting a signal quartermaster in charge of each watch.

Put signal quartermasters first and second class in charge of watches on flagships.

For maneuvers, the second relief watch should be called and each man be given a station as follows:

CHIEF QUARTERMASTER (SIGNALS).

PORT WATCH.		STARBOARD WATCH	
(4)	(2)	(3)	(1)
1. Q. M. 3c., Sig.	1. Q. M. 3c., Sig.	1. Q. M. 3c., Sig.	1. Q. M. 3c., Sig.
2. Sig. 1c.	2. Sig. 1c.	2. Sig. 1c.	2. Sig. 1c.
3. Sig. 2c.	3. Sig. 2c.	3. Sig. 2c.	3. Sig. 2c.
4. Recorder.	4. Recorder.	4. Recorder.	4. Recorder.

Chief quartermaster at high power telescope.

The sections (one watch) on bridge during maneuvers, eight men.

(a) Quartermasters third class to keep lookout for signals from the flagship and see them quickly and properly answered report them to the officer of the deck.

(b) Signalman first class, and signalman second class, at semaphore machine on wing of bridge to send and receive semaphore messages while flag hoists are being made. (2)

(c) Signalman first class and signalman second class, at hook and tail halliards respectively to hook on hoists. (2)

(d) One of the recorders who shows special ability, at the halliards to hoist.

(e) In case a messenger is needed one of the men at the wing of the bridge or a man at the hook or tail halliard can be relieved by one of the quartermasters while he is carrying the message.

ORDINARY CRUISING.

(Four men.) (One watch.)

(a) Quartermaster third class, watch, read signals, report signals.

(b) Signalman first class, hook and tail halliards, send signals.

(c) Signalman second class, hoist signals, assist signalman first class.

(d) Recorder, pencil and signal blanks.

18. With a thorough system of training for signalmen as outlined above, careful selection of competent men for advancement, and continuous training which a separate branch for signals alone can give, our signalmen would soon be faster and our system more efficient than that of any other nation in the world.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A MORE SEA-GOING GRADUATE.

By LIEUTENANT JOHN T. G. STAPLER, U. S. Navy.

Is the graduate of the Naval Academy today, with his commission as an ensign in the navy, going to work out successfully to the best interests of the service? Does the commission carry with it sufficient sea experience; and if not, what modification in the present system could be made, so as to embody a greater period of duty afloat for the undergraduate?

It is right that the graduate of the Naval Academy should be on the same footing as the graduate of West Point. That step has been made, and is one that should stand; but the requirements of the naval service are such, that more time should be given to develop the undergraduate. The ensign going to his first ship, with his limited sea service, is bound to make many errors that should have been made and corrected while a midshipman. The commissioned officer ought to be raised in experience and ability, rather than lowered; for this reason the whole subject of gaining a commission as an ensign should be thought about and discussed.

At present there is not sufficient time, during the three summer cruises, to develop a midshipman into the finished junior officer; one that can take his place without jolts as an element of the fleet. The eight and a half months of the summer cruising is very well occupied with breaking in the recruit. The meaning of the ship routine and the purpose of the fleet is just beginning to dawn upon the fortunate first classman, who has had more than two or three weeks deck duty, when September calls a halt, and the midshipman is graduated, so far as his sea experience is concerned.

It is well to develop a system of preparation which is suited to the special conditions of service and type of individual in our country; but at the same time it is well to keep an eye on the methods employed by other nations in their producing of the

young sea officer. Upon investigation, it will be seen that in other services the commission is not gained without at least three years at sea. Undoubtedly it has been found that such time was necessary to round out the experience of a midshipman, so that he could properly perform the duties of a junior officer; especially as they apply to the handling of the enlisted men.

The course at the Naval Academy is a case of the survival of the fittest. There is so much ground to be covered, that of necessity a midshipman must proceed at high pressure through one subject after another. Time for assimilation and for practical work is perforce limited. Fortunately the postgraduate school has been founded to direct minds that are needed along lines of specialization; but there still remains the need of more time for practical work and sea experience in the undergraduate course.

It is proposed then to gain sea experience for a midshipman, with a period of digestion, by making the undergraduate course one of five years instead of four; the fourth year to be spent entirely at sea, with a return to the Naval Academy for the fifth and last year to command the brigade and gain the diploma. The year at sea would intervene between what, under present conditions, are the first and second class years. It is suggested that the class at sea, under the proposed plan, would be known as the second class, and the entering class, or the "plebes," as the fifth class. The class due for sea, after completing the May examinations and June week, would go on leave for one month, and would then be ordered to the fleet. They would remain at sea for one year and two months, to be exact, when, after another month's leave, they would report at the Naval Academy by the end of September as first classmen, to command the brigade and complete the undergraduate course.

While at sea, it is suggested that the individual members of the class, attached to the respective units of the fleet, be given duty in rotation, following a standard outline of progressive instruction; the cruise record of midshipmen to be given such a multiple, in making up the stand of the class for the undergraduate course, as would insure a tumble to catch the life boat at "man overboard," and a keenness for the steerage sextant, with a taste for steam mixed with indicator cards. While on the long cruise, midshipmen should receive an increase in pay to cover the increased expense incidental to such service. There would be no need for a

change of uniform, except for the addition of a dinner or mess jacket.

The class at sea would fill the need of the fleet for boat officers and an increased number of junior division officers. In other navies boat duty is generally handled by midshipmen and the need of it is felt in our service.

It would seem that this year and two months of sea duty, combined with the two preparatory summer cruises, would make an improved junior officer upon graduation. The fourteen months at sea, besides increasing the information and experience of the graduate, would give the midshipmen an opportunity to assimilate the work of the first three years at the Academy, and to meet in practice many subjects struggled with thereafter in the text books. They would, from the investigation of the different departments of a vessel, instead of the simple contact of the short summer voyage, be prepared beforehand to understand the meaning of the last months ahead of them at the Academy. They should be given thorough instruction in the general store, receiving and handling of stores and in the subject of surveys. The final work for the diploma would be better understood and more thoroughly done.

There is another side to this plan of a year at sea before graduation, that would directly affect the success of the Naval Academy from the point of view of discipline, and the broadening of the outlook of all members of the brigade. The first class would return to the Academy to command the brigade with a wider horizon, and a better understanding of the meaning of things. The meaning of the fleet would be with them, and matters of discipline would move more naturally and smoothly than at present with minds that tend to narrowness in the point of view, due to the very nature of the close application and restrictions necessitated by the course.

The period at the Academy is a test to eliminate undesirable material. The tendency is, for the individual in the struggle for self preservation, to become self centered, and to lose breadth of view along lines of discipline that connect him, as an element of potentiality, to the good or bad interests of the brigade. Sometimes a class is found that is influenced by a few spirits antagonistic to discipline, and is in a negative rut with distorted outlook and sense of proportion, so far as the manner of performing duty

is concerned. Especially is this unfortunate, when the class in question is the first class, one below the standard, and one heedless of its responsibilities. Impressions are left on the minds of the underclassmen that are difficult to eradicate, and the whole tone of the brigade is lowered.

From its year at sea, the first class, with its broadened outlook, would come to combat this narrowness in the point of view, and there would be no question about its ability to command the brigade. Administrative matters with the routine of discipline would be lifted a notch, and given new vigor and significance to the midshipmen. The first class would realize its duty to the service at large, and its importance in connecting that service with the Naval Academy.

Another phase of this subject is whether additional sea experience could not be gained during the regular routine of the academic year at the Academy. The Chesapeake is so conveniently at hand as to make practical, short cruises of a day, or a day and a night, on a training vessel attached to the Academy of about the *Tacoma* class. Would it not be possible to sail during the afternoon of Friday and return by Saturday noon? The unit of detail to be the company; and the company officers to assist with instruction and drills as much as possible. Mess equipment and hammocks to be kept on board the vessel; the midshipmen to take in their clothes bags what they would need for the short cruise. Watch and division duty for the first classmen, with deck seamanship, signals, and boat duty for the underclassmen, would make the time so spent well worth while. Gun crews would take on a new meaning and ship organization would be a matter of study. Target practice could be carried out, after regular training of pointers and crew. Swinging ship and compensation of the compass would pass from one of the mysteries to an every-day affair. In addition, a couple of live torpedo boats with running torpedoes aboard, could in a morning's work do a great deal towards a breaking-in knowledge of the torpedo. If possible, it would be well to have an active group of torpedo boats and submarines based at Annapolis during a part of the year to assist in the training of midshipmen.

Greater naval activity in the waters surrounding the Academy, in which the midshipmen took an active part, could not but tend toward better ultimate sea knowledge. In addition to the cruiser

detailed to make short trips into the bay throughout the academic year, it would be well if one of the battleships in reserve were stationed at Annapolis to permit a following up of a theoretical discussion in construction, engineering or equipment, by a trip of exploration and investigation. The machinery might not be of the most recent design, nor the bow of the latest flare, but basic facts would stand out, to give something tangible to take hold of. Models are excellent; but the originals assembled into the actual ship with the feel of the ship about them are far better.

It is a pity the port of Annapolis is not a port of entry for ships of any great draft. It is with difficulty that a vessel, even of the *Illinois* class, is gotten to within hail of the Naval Academy. With all the dredging that the country is doing, it would seem that a thirty-foot channel and mooring basin could be provided at Annapolis. At present to look out over the harbor and the blue Chesapeake beyond, marked but by an occasional oyster schooner or canoe, makes one feel that there is something wrong with the setting. Yes, it is beautiful, but that before West Point is quite as attractive, and just about as naval.

With the adoption of a year at sea with the fleet, before the last year at the Academy, the necessity of sending the two lower classes to the fleet for the summer would be obviated. It is suggested that, instead, these classes be sent on foreign cruises under the instruction and control of the officers attached to the Naval Academy. The vessels best suited for this purpose would be two of the armored cruisers that are usually held in reserve. The summer cruise for these vessels would be in line with the policy of maintaining fleet efficiency, in the reserve fleet, by occasional trips to sea. Summer cruises across good stretches of ocean to other countries would be broadening and educational to the lower classmen, and more consistent and progressive work could be carried out in all the practical subjects of the course than is possible on a number of different units of the fleet, busy with fleet work, in and out of port. The summer with the fleet is a period of coastwise work in maneuvers and drills, and is not the time for over-sea voyages. It is difficult when operating along the shore to do consistent navigational work. Long days at sea with continual handling of the sextant and uninterrupted engine room watches, that soon become routine, is what the lower classmen need during the first two years. They would get this in an over-sea cruise.

The undergraduate does need fleet contact and knowledge most positively, but this should come when the man is a little older, and is ready for it; that is, during the next to the last year of his undergraduate life. The two previous summer cruises abroad in a training squadron would be the best means of preparing for the year with the fleet. The midshipmen would be permanently attached to the individual vessels then, and more consistent work would be done from a more solid foundation of preparatory work. When men are attached to any job for only a short time, and are more or less supernumeraries, unconsciously the danger is that they become "nobody's pigeon." From observation of the midshipmen in the fleet during the summer of 1912, it seemed that what they lacked, was sleep and more days at sea with the meridian altitude in hand, instead of the first watch ashore almost every night at the dance.

The physical condition of the midshipmen, that spent the summer in the fleet, was noticeably below par upon their return to the Academy at the end of September. Their condition in regard to strength and endurance at the beginning of the last academic year, as compared to the physical condition of the brigade on former returns, was remarked upon by those in charge of the physical training. Midshipmen going to the fleet, in the plan proposed, would be a year older. They would have a permanent job to make good at, and the need of a cruise record that would assist their final stand. They would not be casually looking in at a ship; they would be a part of her. The camp work and drill of the winter weeks at Guantanamo would build them up physically.

It is believed that the five-year course, with two summer voyages and a year in the fleet before graduation, has advantages over the present system. The question arises how to arrive at the five-year period from the course of today? There are several ways in which the change could be made; but perhaps the best would be by the use of a transition year. For example: Take any second class of the present course and divide it into two sections according to class standing. Then, allow the first section to proceed as the regular first class to graduate the following year. Next, make the second section of the class the second class under the new course of five years; and send them to sea for fourteen months, as outlined in the plan proposed, to return at the end of that time for their first class year. The entering class to be known as the fifth

class; the other classes to take their names accordingly. With the large classes now passing through the Naval Academy, a class could be divided, and still there would be an ample number of men in each half to more than fill all positions in the brigade organization that are usually detailed from the first class. The policy of graduating a class by sections was carried out in the case of the class of 1907. It would be no more difficult to arrange to graduate the first half of a class on time, and the other half a year later after its fourteen months with the fleet.

A more sea-going graduate is needed; and there is no reason why he should not be produced from the material now in training. "Ex Scientia Tridens," yes! But let more of the knowledge be gained from the open road of the sea.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A KHAKI UNIFORM NEEDED FOR THE BLUEJACKET LANDING FORCE.

By ENSIGN B. N. MCCANDLISH, U. S. Navy.

Certain classes of vessels in our navy have more need for an effective landing force than for good shooting with the ship's guns. Yet the landing force is thrown ashore either in white or blue uniform. A better target could hardly be presented than men in such uniform.

The Army and the Marine Corps are training with 800 yards as a battle range. That is, effective and rapid shooting is supposed to be sustained at any range under that. Sights are laid flat at 800 yards range and are not touched as the enemy advances. This is a result of the flat trajectory of the modern rifle.

In "The Landing-Force and Small-Arms Instructions" a sentence reads "Visibility draws fire." Officers who were landed in Guantanamo in 1909 quote examples of the ease with which the marines made approaches without being discovered whereas the bluejackets in their whites were visible at all times. Surgeon Hoyt, U. S. Navy, tells of the expedient used by our men in Nicaragua of rolling in the mud to decrease visibility.

Many naval officers state that our landing force is under fire so seldom that we can afford to put men ashore in our present uniforms. Reasoning the same way, we might equip them with flintlocks or with old Springfields. Out in China and in Central America our gun-boats are often called upon to land men in emergencies. These men should be ready to do actual and effective fighting. True the khaki would complicate the question of keeping the crew in uniform, but that is a disagreeable feature that should be borne with.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE PANAMA CANAL.*

By R. E. BAKENHUS, Civil Engineer, U. S. Navy.

There could be no better introduction to an article on the Panama Canal than the enthusiastic words of Ambassador Bryce in a recent chapter on the Isthmus of Panama, where he says, in referring to the canal:

> There is something in the magnitude and the methods of this enterprise which a poet might take as his theme. Never before on our planet have so much labour, so much scientific knowledge, and so much executive skill been concentrated on a work designed to bring the nations nearer to one another and serve the interests of all mankind.
>
> In no previous age could an enterprise so vast as this have been carried through; that is to say, it would have required a time so long and an expenditure so prodigious that no rational government would have attempted it.

It is true we have elsewhere done work of comparable magnitude—the tunnels under the Hudson and East Rivers, the great railroads and terminals, the Erie Canal, the city subways and water-supply systems, the reclamation projects and great bridges—but these are all intimately interwoven with our daily life and progress. The canal is a project crystallized from the vast multitude of enterprises and is indisputably the greatest of them all.

*The following maps and plans accompany this article:

Plan No. 1: Official map showing Isthmus with completed canal.

Plan No. 2: General map showing Atlantic Division, including breakwater, sea-level section and Gatun Dam and Locks.

Plan No. 3: General map showing Pacific Division, including Miraflores Lake, Locks, sea-level section and breakwater.

Plan No. 4: Cross-sections of the canal at various points.

Plan No. 5: Profile of Panama Canal.

Plan No. 6: Plan and longitudinal sections and cross-sections of Gatun Locks.

With a subject so vast, and one that has attained historic interest and ranks as an engineering work of such magnitude, it seems necessary to give a résumé of the early history, and consider it in connection with events that may be well known in other connections.

EARLY HISTORY.

One of the most interesting subjects connected with the Panama Canal is the history of the canal idea. To study its conception carries us back to the Middle Ages—to the conditions so well described by Fiske in his "Discovery of America," when Genoa and Venice were the great commercial rivals and Spain was a rising power. Following Marco Polo's marvelous travels from 1269 to 1295, throughout Asia, and that of his adventurous successors, a great trade developed with the Orient, which proceeded unchecked via the Mediterranean and the ancient overland routes until the hostile Mohammedan Turk, recovering from two centuries of repression from the Crusades, overflowed his own dominions and entered the Balkan peninsula. In 1453 Constantinople was taken by the Turks, and the alliance between that city and Genoa was broken. This great commercial metropolis, through the persistent attacks of the Turks, was gradually deprived of her route to the Orient and thus of her commerce. The commerce of Genoa's great and only rival, Venice, had a similar fate.

Tremendous pressure developed for the finding of some new route to Cathay, as the other conditions for trade were most favorable. The world's ideas of geography at that time were of the crudest fashion. America was unknown. Africa had not been circumnavigated; its southern limits were enveloped in a haze of conjecture and ignorance. It was known that Asia did not extend indefinitely to the East and was not bounded by limitless swamps, as had been supposed. With the increasing hazards of the route to Cathay and the lands of spices, and the rising expectations of wealth and riches fed by the avaricious and adventurous spirit of the Middle Ages, the minds of men were forced to think of the possibility of other routes.

In the discovery by Dias, in 1486, and the confirmation by Vasco de Gama, in 1496, of the route to India by circumnavigating Africa, we are not now interested except to know that the

presence on the first of these voyages of the brother of Christopher Columbus acted as a stimulus to the mind of the great explorer. He, as we know, put the unique idea of reaching Cathay by sailing westward to the test of four actual sea voyages. The results we know, but we must bear in mind that the discovery of the American continent was a mere incident and that what Columbus was really seeking was a passage to the Orient, and for this he continued his search on his three subsequent voyages. His ships ran their noses into the bays and inlets in the hope that they might forge on to the desired lands. The full truth was never known to Columbus; he little realized, when his ships were at Porto Bello, that only forty miles overland were the waters—could he only reach them—which would carry him to his much-sought-for goal, and thence to Spain. Succeeding explorers continued these efforts, and every indentation of the eastern coast line of the Americas was explored by Spanish, Portuguese, English and Dutch ships, only to dim the hopes that the passage could ever be found.

It remained for Balboa, led on by tales of friendly Indians, to gain the knowledge of what lay beyond, after an overland journey not far distant from the site of the present canal. The discovery of the Pacific in 1513 only intensified the mariners' desires to penetrate with their ships.

The discovery in 1520, by Magellan, of the straits named after him, his entry into the Pacific, and the completion of the circumnavigation of the globe in 1522 by a part of his expedition, did not solve the problem and only emphasized the desirability of a conveniently located passage.

The actual results of the epoch-making discoveries overshadowed the original aims of the explorers. From being a primary aim, the search for the interoceanic passage, with the gradual ushering into the known world of the two continents, became secondary. The exploration and development of the newly found lands afforded a boundless outlet for the restless spirit of the times. The canal idea, having had its genesis in such great world events, was now to enter the next stage of its development.

It is remarkable that the desire for the passage has persisted throughout all these centuries. The increase in geographic knowledge, the correct understanding of the relation of the

Americas to Europe and Asia, political history, the invention and building of railroads, and finally the phenomenal development of the American continent itself, have all brought out new phases of the problem and altered the point of view; but in all its phases it has remained one of the great ambitions of the human race.

The Americans will not have the honor of sending the first ship across the Isthmus. Balboa and his successor, Gil Gonzales de Avila, both carried ships across—Balboa after building them near the source of lumber supply on the Atlantic side and then dismantling and re-erecting them on the Pacific side, and de Avila after dismantling the ships that had carried him across the ocean. Their enterprise and energy are greatly to be admired. Untold difficulties beset the journeys through the jungle, and in Balboa's first crossing, one authority states the number of deaths amongst the Indian cargadores to have been five hundred, and another places the number at two thousand. The object in crossing the Isthmus was exploration on the Pacific side, especially investigations of the reputed gold in Peru. Subsequently there was much traffic with the Pacific coast, which was carried across the Isthmus and reshipped.

Charles V of Spain, who succeeded to the throne in 1516, encouraged the explorations of the South Sea, as the Pacific was then known, and urged his American governors, if possible, to discover a strait by systematic exploration. The expedition of Gil Gonzales de Avila along the Pacific shores had this object. He discovered Lake Nicaragua, which has played such an important part in the interoceanic canal question. No strait being found after years of search, Charles in 1534, by a royal decree directed examination to be made of the land between the Atlantic town of Chagres and the Pacific with a view to the establishment of water connection. It is reported that even as early as 1520 surveys were ordered by the Emperor. The result of the royal decree was that the local governor declared the work to be impracticable and beyond the resources of any sovereign.

In the meantime a considerable commerce developed across the Isthmus. The city of Panama was founded on the Pacific side in 1517, and Nombre de Dios, founded in 1519, was the most important post on the Atlantic side. Between the two a road was built and a series of posts established. Later Porto Bello, due to a better harbor and superior location, was made the Atlantic

terminus and a new road to Panama was built of such a character that portions of it may be used to this day. Subsequent to 1534 a partial water route was established for boats and light-draft vessels up the Chagres as far as Cruces by removal of obstructions from the river. This is the identical stream and valley which nearly four hundred years later is being utilized as the Atlantic end of the Isthmian Canal. The establishment of the partial water route did not lead to the discontinuance of the paved way. With the conquest of Peru by Pizarro in 1533-1535, the trans-isthmian trade grew in amount and value and the Spanish colonies continued to prosper. Panama became a great collecting and distributing center for Spanish commerce.

So lucrative and so extensive did the trade become that under Philip II, who succeeded to the throne on the abdication of Charles V in 1555, the search for a strait was given up and all idea of a canal abandoned. With untold treasures coming to Spain by the existing means of transport, the Emperor did not desire to seek new means of intercourse which might benefit a rival nation as much or more than Spain, and furthermore all the energies of the people were fully occupied in developing the existing sources of treasure and none seemed available for new enterprises. The same policy continued for about two centuries.

In the meantime trade developed and the terminal towns grew. Panama in its day was the great metropolis of the New World having pretentious stone churches, monasteries and numerous dwellings of wood. Its markets and those of Porto Bello were the meeting-places for the merchants of Peru, the Isthmus, and of Spain. Great quantities of silver and gold passed eastward and supplies from Spain came in the opposite direction. The transportation across the Isthmus was by mule train. All others than Spanish were excluded from the traffic; the richness of the trade and the overbearing stand of the Spaniards encouraged piratical attacks by the seamen of the northern nations on the shipping of the Atlantic and Pacific coasts, and even on the overland mule trains. Between the years 1570 and 1596 Sir Francis Drake made numerous privateering attacks which were very much of the nature of piracy. The Spaniards were sending their merchant ships in fleets twice a year, convoyed by six and eight armed vessels. Drake was followed in his enterprise by the buccaneers who reached the limit of their power under Henry

Morgan. Morgan with great energy and daring captured Nombre de Dios and immediately after conducted operations against Porto Bello. He turned what was nearly a failure into a cruel success, and a year later, in 1671, according to his threatened promise to the governor of Panama, he returned to ransack the city of Panama. After a wretched trip across the Isthmus, almost without food, the city was attacked and fell into the hands of Morgan. As a result of his raid the city was destroyed, and to this day the ruins of old Panama, the massive stone walls and towers of churches, monasteries and forts still remain as mute and impressive evidences of the constructive energy of the Spaniards and of the wicked, destructive energy of the English buccaneers. After a systematic plunder of all the valuables of the city, Morgan left. The town was never rebuilt in the old location.

The trade of Panama suffered a period of decline after the Indian empires had been stripped of their valuables. A royal cedula in 1593, forbade trade with China and the East Indies; the development of local industries was forbidden through rival influences at home; corrupt governors did the colonies no good, and there were various governmental restrictions on trade and growth. Even the roadway across the Isthmus entered a period of disuse, and the traffic between Spain and the Western ports went via the Cape of Good Hope or Cape Horn, except a certain amount crossing at Tehuantepec.

In the latter part of the eighteenth century certain desultory efforts were made toward a canal, including an examination of the Nicaragua route in 1779 to 1781, followed by a discouraging report. Even so, a company was formed to undertake the project and selected a route utilizing Lake Nicaragua. By 1823, when all the continental colonies had secured their independence by revolt, all Spanish effort and influence ceased.

MODERN CANAL PROJECTS.

With the demise of Spanish authority on the continent there was an early active revival of canal projects. In fact, as early as 1825 the minister of the then Central American Republic to the United States addressed the Secretary of State, inviting attention to the willingness of the Republic to receive the cooperation of the United States in the building of a canal by a group of

American merchants. The United States gave a favorable reply, but nothing resulted then. In 1826, however, the Republic of Central America actually accepted the proposals of an association for the building of the canal under liberal terms. The attempt to organize a company with $5,000,000 of capital proved unsuccessful. In 1830 the Central American Republic negotiated with a Netherlands company, and the United States hearing of this, informed the Republic that it would expect the same rights and privileges of passage through the canal as other nations. In 1835, at the initiative of the United States some investigations were begun, but were dropped in 1837 upon the advice that the time was not propitious. Another project started in 1838, and a still further investigation and an estimate of $25,000,000 were made in President Van Buren's administration, but the Isthmian country was too unsettled and revolutionary for any definite progress to be made. There are records of still other efforts in 1826, 1827 and 1838. In the latter year a concession was granted to a French company to build roads or canals. As a result a canal was recommended by Napoleon Garella with a starting-point in Limon Bay, thence to a connection with the Chagres River below Gatun. The divide was to be crossed by means of a series of eighteen locks on the Atlantic side and sixteen on the Pacific side, with a summit level 158 feet above the sea, and the highest part of the divide penetrated by a tunnel over three miles long. The report of actual conditions by Garella discouraged the promoters.

During all this period the United States was peopled only on the Atlantic seaboard and was interested in commerce which started or terminated in Atlantic ports only. In the middle of the century events occurred which were destined to greatly increase the importance of the Isthmus, and to have a strong influence in pushing the canal idea to the point where its actual execution was bound to follow. It was the acquisition of California, the discovery of gold therein, the exploration and settlement of the Northwest Territory, and to a lesser extent the purchase of Alaska, which led the United States on to its destiny as a Pacific as well as an Atlantic power and thus established the conditions that ultimately made the canal a certainty. The trans-isthmian route for freight and passengers regained its old-time importance, and curiously enough it was again the search for gold that gave the impetus. A railroad across the Isthmus followed promoted

by Americans. The success of this road was continuous on account of the increasing amount of traffic. Even the establishment of the transcontinental railroads did not vitiate the importance of the trans-isthmian road, nor did any of the railroads have a real deterrent influence on the canal scheme.

Almost innumerable projects, examinations and reports were made during the latter half of the nineteenth century, in which the United States, France and Great Britain led. Prior to 1850 no extensive and accurate surveys had been made. After that date work was done in earnest; no longer were the results of reconnoissances afoot or on horseback sufficient; the methods of modern engineering were taking their first grip upon large enterprises, and no company or government could entertain a proposition not based on surveys by engineers and on detailed estimates of cost. Several companies were incorporated, including the American, Atlantic and Pacific Ship Canal Company in 1850. All failed from one reason or another to do much more than organize or conduct surveys. Always some insuperable obstacle was met. It is no doubt true that very few fully realized the enormous difficulties that subsequent experience disclosed, and fortunately so, since the enthusiasm for the idea might have received a setback from which it could not have easily recovered. A predicted cost of $400,000,000 would have made the enterprise seem impossible.

In 1869 official recognition was given to the subject, and President Grant's first message to Congress called attention to the advisability of an American canal on American soil. The appointment of a commission was authorized by Congress, known as the Inter-Oceanic Canal Commission, who not only examined all available data previously gathered by others, but had new data collected and had access to new surveys made principally under the direction of officers of the army and navy, covering the Panama, Nicaragua and Darien routes. In 1876, after six years work, the commission reported that "After a long, careful, and minute study of the several surveys of the various routes, the one known as the Nicaragua route . . . . possesses, both for the construction and maintenance of a canal, greater advantages and offers fewer difficulties from engineering, commercial, and economic points of view than any of the other routes."

A further survey of the Nicaragua route was made in 1885 by

order of the Secretary of the Navy. This was followed in two years by the organization of the Maritime Canal Company of Nicaragua, incorporated by Congress and having a concession from the Nicaraguan government. The company actually dug a portion of the canal on the Atlantic side, but failing to secure government aid the concession lapsed and the property reverted to the State.

In 1895 the Nicaragua Canal Board was appointed by the President by authority of Congress. The board visited Nicaragua, conducting investigations, but in the six months allowed them did not have sufficient time for further necessary explorations, for collecting the vast amount of information and reaching a definite conclusion on so momentous a matter, and accordingly recommended a further board. As a result the Nicaragua Canal Commission of 1897 was appointed, and in its report of May 1899, proposed a route which followed closely the one suggested in 1852. The United States was apparently committed to the Nicaragua route. The Panama route had been pre-empted by the French, but their hold was loosening. Congress in its next step authorized a further commission with greatly extended authority, to consider the Panama as well as the Nicaragua route and to evaluate work done by any private company, having in mind the French. The first Isthmian Canal Commission was accordingly appointed in 1899—a distinct broadening in scope and title from those of the previous boards and commissions.

FRENCH CONTRIBUTION TO THE ENTERPRISE.

At this point it is well to pause in the account of American doings, to consider briefly what the French had contributed since the middle of the century to the canal idea and to construction. In 1844 a French engineer, after surveys having both a railway and a canal in view, made an accurate report concerning Panama, all in the interests of a French company holding concessions. Like so many others the project failed and the concessions lapsed.

At the Congress of Geographical Science in 1875, in Paris, M. Ferdinand de Lesseps came upon the scene with the sweeping announcement that in his opinion the authors of all plans up to that time had committed the serious error of examining only canal routes with locks, and that the interoceanic canal in order to meet the requirements of navigation, must be constructed at

sea-level like the Suez. Thus early did he show that the elements of his character—force, unbridled enthusiasm, convictions without investigation, and a sublime faith in himself—which had carried him on to a magnificent success in the straightforward problem at Suez, were, in the infinitely more difficult problems at Panama, to make of him a consummate blunderer and a deceiver, brushing aside and ignoring the advice and estimates of competent and trained engineers when they did not follow his own preconceived ideas, and leading many unfortunate investors, including himself, to financial ruin. Under such a leader the French project was foredoomed to failure. De Lesseps, so far as the French were concerned, made the project his own; he dominated the committees, moulded a popular sentiment, all being eager to follow his lead; if doubts arose, his was the reassuring word, and at his solicitation the subscriptions to the stock of the company poured in. His success at Suez was his most valuable asset and had indeed placed him on a pinnacle. He was a man of undoubted ability, but lacked an element of discrimination which should have caused him to appreciate the true magnitude of the problems before him. De Lesseps having attempted great projects must be measured by great standards. He did not lack strong opposition nor able expert advice, but he beat them down with the same indiscriminating ability as he did natural obstacles and the financial troubles that interfered with his idealized delusion of a sea-level canal.

In 1876, a French committee with De Lesseps at the head was formed; also, in 1876, a civil association undertook actual surveys, which were under the direction of Lieut. L. N. B. Wyse. In May, 1878, after completing the surveys, Lieutenant Wyse secured for his association a concession from the government of Colombia for a ship canal. This was the real beginning of the canal which, after many vicissitudes, is now almost completed. An international congress of surveys was held in Paris in 1879, and after elaborate discussion decided on the route from the Bay of Limon to the Bay of Panama, and that it should be at sea level. The decision for the sea-level canal was by no means unanimous. "When one reads the reports of the sessions of that commission, one constantly recognizes the inspiration of M. de Lesseps, one perceives the action of his will, so persistent in forming a general opinion in favor of a plan for a canal on a level." There were

those who foresaw the difficulties and who advocated a lock canal. In fact, de Lesseps had against him the majority of the engineers and contractors. The predicted cost was 1,200,000,000 francs, and the time twelve years. About three months later the Universal Interoceanic Canal Company was formed, but less than one-tenth the stock was subscribed on the first attempt. De Lesseps did not have a bed of roses; he consented to new surveys and new estimates, and he personally went to the Isthmus in December, 1879, accompanied by the International Survey Commission. The surveys were accomplished and the conclusions reached in a time so incredibly short as to cast doubt upon their reliability. The estimate of cost was 834,000,000 francs, and of time eight years, both remarkably lower than those of the year before by the technical commission. The estimate of cost was still further reduced to 685,000,000 francs by de Lesseps himself, leaving it less than sixty per cent of the original estimate, which was considered low by competent persons. Later a firm of contractors, Couvreux & Hersent, favorable to the views of de Lesseps, estimated the cost of the canal to be 500,000,000 francs, and they undertook a contract on a cost-plus-profit basis. The annual revenue of the completed canal was estimated at 90,000,000 francs. The stock issue of 300,000,000 francs was doubly subscribed. The contractors performed the two years of preparatory work at cost plus six per cent. By the end of that time, December, 1882, it was clear that the predicted unit costs and rates of progress could not be reached, and the contract was annulled on the contractors' proposal.

The Superior Advisory Commission was formed in 1881, composed of men eminent as engineers and technicians. This commission was dominated by de Lesseps through his personal force, and their acts did not result in clearing the situation.

To carry on the work abandoned by the closing of the contract, the canal company in 1883 secured the services of M. Dingler, an able engineer, to supervise and direct the operations on the Isthmus. The developments of the next few years were a voluminous report by the chief engineer on the sea-level canal project; discovery that the quantity to be excavated was 120,000,000 cubic meters, rather than the 75,000,000 estimated by the International Commission or the 45,000,000 estimated by the International Congress; the award of a series of small contracts and establish-

ment of work yards; the realization in July, 1885, that less than one-tenth of the excavation had been completed although four of the eight years allowed for construction had elapsed; the return to the former estimate of 1,200,000,000 francs; a reorganization involving the award of large contracts for completing the canal in five sections by 1889; the announcement by de Lesseps, in 1886, after a visit to Panama of his utmost confidence in the speedy completion of the canal; further successful bond issues; renewed attacks on the feasibility of the sea-level canal based on reports by expert engineers of incontrovertible facts, but ineffective on de Lesseps; the weakening of public and financial support, and the final capitulation of de Lesseps to the lock-canal idea, but only as a temporary expedient to hasten completion and to be followed by a deepening to sea level. These events were followed by the ineffectual attempt to issue a series of lottery bonds on authority of the Chamber of Deputies, which foreshadowed the financial *débâcle* of the enterprise. Receivers were soon appointed and the affairs of the company were wound up. De Lesseps and his son were tried, convicted and sentenced by the courts of France to pay a fine and serve a term of five years imprisonment. The sentence against the son was reversed, and that against the father was never executed. He became a complete wreck, both physical and mental, and died in 1893. The company had actually expended about 1,300,000,000 francs and had accomplished about 55,000,000 cubic yards of excavation on the permanent work, or less than one-half the total on the French plan.

After careful investigation and a great deal of difficult work, the receiver, in 1894, launched a new company to complete the lock canal. An extension of time had been secured from the Colombian government through the agency of Lieutenant Wyse. The first step of the new company was to reinvestigate the whole subject of the canal, which was done through the appointment of the "Comité Technique" of engineers of international eminence, including two Americans. Their work was most thorough, comprehensive, and to the point. Later, in accordance with the charter of the company, a commission of five members was appointed to make final recommendations, who reported:

. . . that the adopted project is practicable under the conditions of time and expense indicated, and that the New Company has demonstrated that by works which will not exceed an outlay of about one hundred million dollars, and a duration of about ten years, it is possible to open the Panama Canal to extensive commerce, to remove the obstacle which the Isthmus opposes to international communication, and thus to complete an immense work that interests all the nations of the world and is the greatest which human genius has ever planned.

There was to be a summit level and an artificial lake at Bohio with the necessary locks, 738 feet long and 82 feet wide, and sea-level connections. There is every reason to believe that the enterprise was feasible and would have been carried through. The company, as a matter of fact, did only enough work to care for the extensive plant and excavated about 5,000,000 cubic yards in five years, but the valuable and necessary progress made was in the way of gathering scientific information that was absolutely essential and which the old company did not have, and which later proved of the greatest benefit to the United States. The financing of the enterprise became impracticable, due to the United States coming into the field as a probable canal builder. The French were truly leading a forlorn hope and finally their only chance lay in selling out to the United States.

TRANSFER OF CONTROL TO THE UNITED STATES.

The Isthmian Canal Commission of the United States, in the two and one-half years from June, 1899, to November, 1901, made most elaborate investigations of the whole canal problem, covering the first Darien route from the Gulf of San Blas to the Gulf of Panama; the second Darien route from Caledonia Bay to San Miguel Bay, an arm of the Gulf of Panama; the Panama route from Limon Bay to Panama Bay; and the Nicaragua route from Greytown via the San Juan River and Lake Nicaragua to Brito on the Pacific, and other less important routes. An immense amount of literature, reports and surveys turned out by previous boards was accessible, including the most excellent and complete data in the hands of the New French Company. Besides all this, much additional surveying and investigation was a necessity,

The commission evaluated the French property as follows:

Useful Canal Excavation	$21,020,386.00
Chagres Diversion	178,186.00
Gatun Diversion	1,396,456.00
Railroad Diversion	300,000.00
Contingencies	4,579,005.00
Panama Railroad Stock	6,850,000.00
Maps, Drawings and Records	2,000,000.00
Total	$36,324,033.00
Add about 10 per cent to cover omissions	3,675,967.00
Grand total	$40,000,000.00

The French company submitted an estimated valuation for purpose of discussion with a view to sale to the United States, of $109,141,500.00. The commission estimated the cost of completing the Panama Canal to be $144,233,358.00, to which must be added the commission's evaluation of the French property, or a total of $184,233,358.00, or adding the company's offer to the cost of completion, a total of $253,374,858.00. The commission estimated the cost of building the Nicaragua Canal to be $189,864,062.00.

A lock type was found to be obligatory on the Nicaragua route, and either a sea-level or lock canal was found possible on the Panama route, but the commission strongly recommended the lock canal and reported on the relative advantages of the two schemes as follows:

The estimated annual cost of maintaining and operating the Nicaragua Canal is $1,300,000.00 greater than the corresponding charges for the Panama Canal.

The Panama route would be 134.57 miles shorter from sea to sea than the Nicaragua route. It would have less summit elevation, fewer locks, 1568 degrees and 26.44 miles less curvature. The estimated time for a deep-draft vessel to pass through is about 12 hours for Panama and 33 hours for Nicaragua. These periods are practically the measure of the relative advantages of the two canals as waterways connecting the two oceans, but not entirely, because the risks to vessels and the dangers of delay are greater in a canal than in the open sea.

Except for the items of risks and delays, the time required to pass through the canals need to be taken into account only as an element in the time required by vessels to make their voyages between terminal ports. Compared on this basis, the Nicaragua route is the more advantageous for all trans-isthmian commerce except that originating or ending on the

west coast of South America. For the commerce in which the United States is most interested, that between our Pacific ports and Atlantic ports, European and American, the Nicaragua route is shorter by about one day. The same advantage exists between our Atlantic ports and the Orient. For our Gulf ports the advantage of the Nicaragua route is nearly two days. For commerce between North Atlantic ports and the west coast of South America the Panama route is shorter by about two days. Between Gulf ports and the west coast of South America the saving is about one day.

The commission's recommendation was that,

After considering all the facts developed by the investigations made by the commission and the actual situation as it now stands, and having in view the terms offered by the New Panama Canal Company, this Commission is of the opinion that "the most practicable and feasible route" for an Isthmian Canal, to be "under the control, management, and ownership of the United States," is that known as the Nicaragua route.

When this information reached Paris the French company were at our mercy and capitulated with a cabled offer to sell for $40,000,000.00, to the United States. The Isthmian Commission then made a supplementary report, dated January 18, 1902, as follows:

The unreasonable sum asked for the property and rights of the New Panama Canal Company when the Commission reached its former conclusion overbalanced that route, and now that the estimates by the two routes have been nearly equalized the Commission can form its judgment by weighing the advantages of each and determining which is the more practicable and feasible . . . After considering the changed conditions that now exist, the Commission is of opinion that "the most practicable and feasible route" for an Isthmian Canal, to be "under the control, management, and ownership of the United States" is that known as the Panama route.

The report and plans of the commission of 1899-1901 are most comprehensive covering the subject from the earliest times, and forming a veritable mine of information.

The American desire for a trans-isthmian canal had now become a determination. The demands of commerce were intensified, and the trip of the U. S. S. *Oregon* around South America had made clear the immense potential value of the canal to the navy. During the succeeding moves the American side of the case was handled with great skill and acumen, for which the able report of the Isthmian Commission had paved the way.

The Spooner law became effective on June 28, 1902, and authorized:

(a) The purchase of the rights and property of the New Panama Canal Company at $40,000,000.00, including the stock of the Panama Railroad.

(b) Acquiring from the Republic of Colombia perpetual control of a strip of land, together with all water rights, and the right to build and perpetually maintain a canal, together with the right to exercise sanitary control over the strip of land and the cities at either end.

(c) The actual building of the canal on the Panama route.

(d) The making of all arrangements for the complete building of a canal on the Nicaragua route, should the negotiations with Colombia or with the New Panama Canal Company prove unsuccessful.

(e) The creation of an Isthmian Canal Commission of seven members, four of whom were to be skilled engineers, and of the four, one to be an officer of the Engineer Corps of the United States Army, and one an officer of the United States Navy.

(f) The act appropriated $10,000,000.00, to be immediately available and authorized a further sum of $135,000,000.00 (besides the $40,000,000.00 for purchase of the canal company's property) in case of adoption of the Panama route, or of $185,000,000.00 in case of adoption of the Nicaragua route.

During the negotiations with Colombia the hopes of the stockholders in the French company were alternately raised and dashed as the trend of affairs indicated the adoption of the Panama or of the Nicaragua route. The Colombian government which had the sovereign rights over the Isthmus, failed to ratify the treaty, and soon thereafter the Department of Panama led a successful revolt. The new Panama government, after being recognized by the United States, concluded a treaty which was very satisfactory and which was proclaimed February 26, 1904. The purchase from the French Canal Company was soon consummated, and on May 4, 1904, the United States took possession of the site and property. The occasion was a momentous one. The men who had accomplished so much in clearing the way for the building of the canal, looked forward with confidence to its speedy and successful construction. There were many others who looked with fear and trepidation upon the undertaking. There was a general feeling that after almost four centuries of reports, investigations, surveys and failures, it was

time for the dirt to fly immediately. Fortunately those placed in charge of the work were trained in the scientific planning of large undertakings, and while certain excavation work was done to appease the popular demand, and also to secure experimental data for excavating and planning, the great problems of the moment were recognized as three in number: first, to decide on the type, form and exact location of the canal; second, to outline the method of attack and to purchase and assemble the vast amount of equipment and material; third, to perfect an organization of the administrative and working forces.

PHYSICAL CHARACTERISTICS OF THE CANAL ROUTE.

While the size and character of the canal were open questions, the general location was determined. The line of cut adopted by the French had been selected by some of the early exploiters; the Panama Railroad had been located in the same valleys and depressions; and the French had actually begun to build along this line. At this point it is well to consider briefly the character and topography of the canal route and adjacent territory as it was before any work was done, but bearing the future canal in mind.

The Isthmus of Panama if it joined the two continents by the shortest line would extend northwest toward North America and southeast toward South America; but it does not follow the shortest line, and on the map looks as if South America had been pushed northwestward and the narrow part of the Isthmus on the end toward South America had been bent out of shape with a bulge to the north and the concave side to the south, almost forming a semicircle enclosing the Gulf of Panama. (See plan No. 1) Near the head of this Gulf is an indentation known as the Bay of Panama. This bay touches that part of the rough semicircle where the Isthmus sweeps to the northeast toward the top of the semicircle, and where a line at right angles to the Isthmus is about northwest. This northwest line from the Bay of Panama ends in the Bay of Limon, on the Atlantic side, and happens to pass through the region where the Continental Divide is much lower than anywhere else and where the Isthmus is less than 36 miles wide, only 5 miles wider than at the very narrowest point. The line if slightly distorted may be made to pass for three-fourths of its length along the valley of the Rio Grande River on the Pacific side, and the valley of the lower Chagres on the Atlantic

side, except that the Chagres before reaching Limon Bay turns off to the left to its mouth, seven miles west of the bay, while the line continues straight to Limon Bay. This is in general terms the course of the canal.

The Bay of Limon faces almost directly north, and has an opening three miles wide into the Caribbean Sea, and extends five miles inland of the full width. The depth of the water varies form 5 feet to 36 feet. (See plan No. 2.) The Atlantic end of the French canal was cut through the swamps along the east shore of Limon Bay and extended into the bay, so as to make use of Colon as a protection from northerly seas. Limon Bay, on the Westerly and inland sides, is surrounded by much higher land, except that the lowlands of the small Mindi River valley extend inland from the above-named swamps almost through the ridge, which is here very low. The narrow strip of lowland continues inland beyond the Mindi River valley and dips into the Chagres valley near Gatun. One would almost have expected the Chagres River to seek outlet straight ahead in Limon Bay, only three miles distant; but the little ridge between the Chagres and the headwaters of the Mindi River prevented this, and so the Chagres follows the lowlands behind the ridges surrounding Limon Bay and discharges into the Carribean Sea about seven miles west of the bay. At Gatun, where the line of the canal first meets the Chagres, the valley is about a mile and a half wide, but as we follow upstream it becomes very much wider. The stream is sluggish and winds in and out amongst the swamp lands.

Just above Gatun the Chagres receives an important tributary, the Gatun River. It was of some importance in the plans for any canal of which the sea-level portion extended inland beyond Gatun, for either the canal had to cross the river, to take its flow, or otherwise the river must be turned off before reaching the canal by a new channel or diversion to the sea. The French actually built a very wide diversion to the sea, 8 miles long. The Trinidad River enters the Chagres from the other side, about three miles above Gatun.

Throughout this portion of the Chagres the water-surface is but little above the sea-level, and it so continues as far as Bohio, 16 miles inland by the canal line from Colon. At Bohio the valley contracts, and this was the site selected for the locks and dams in the French canal, and in one of the early American plans.

The land surface from Bohio upstream becomes gradually more undulating and the slopes of the valleys become steeper. At Bas Obispo, 13 miles inland from Bohio by canal line, or 29 miles from Colon, the low water level of the river rises to 45 feet above the sea. Up to this point the Chagres valley leads in a fairly direct line toward the Pacific Ocean, and fortunately approaches the low point of the Continental Divide. Now the canal line must leave the Chagres, for the river makes an abrupt turn and to follow it to its sources would carry us into the mountains to the northeast; that is, into the apex of the roughly semicircular part of the Isthmus. The canal builder cannot dismiss the river from his mind at the point where the line of the canal leaves the valley, for some of the most important problems of the canal are dependent upon the character of the stream above Obispo, and to these we shall return.

At Bas Obispo the Chagres River is joined by its tributary, the Obispo River, the valley of which offers the best opportunity for continuing the canal for the next 4 miles. The continental ridge begins at Bas Obispo, and with it the hills become higher. The stream is tortuous, and the canal line cannot follow it but must be cut on more direct lines to avoid objectionable curvature.

The elevation of the ground is constantly increasing, reaching a low summit at Empire, and the highest summit at Culebra, where the future canal passes between Gold Hill and Contractors Hill. The highest elevation of the ground on the center line is 312 feet above sea-level, but the highest part of the sloping sides will be 554 feet above sea-level. Culebra is about 6 miles from Obispo, and about 35 miles from Colon. The country falls much more rapidly on the Pacific side, and 3 miles beyond Culebra, close to Pedro Miguel, the level is lower than at Obispo, 8 miles back.

The Continental Divide covers a distance of 9 miles from Bas Obispo through Empire and Culebra to Pedro Miguel, and of this the deepest part is 6 miles in length from Las Cascades to a point near Pedro Miguel, and forms the heaviest part of the so-called Culebra Cut. From Pedro Miguel to Miraflores, a distance of 1½ miles, the land continues to fall, and the canal fortunately finds the low valley of the Rio Grande as an available path to the Pacific. This valley from Miraflores to the sea is very little above the sea-level, while beyond the lowlands it is lined on both sides with much higher ground and hills, of which Sosa Hill and

Ancon Hill are the best-known. The distance from Colon to Miraflores is about 39½ miles, and from Miraflores to the Pacific is 5½ miles, or a total of about 45 miles from Colon to the shores of the Pacific.

The waters of Panama Bay vary in depth from 7 to 32 feet, and the bottom slopes off into the deeper waters of the Gulf of Panama and the Pacific Ocean. (See plan No. 3.) About 2½ miles off shore from the mouth of the Rio Grande is a group of islands with both low-lands and mounds. The question as to whether the canal should pass to the east or to the west of them was decided one way by the French and the opposite way by the Americans, the reasons for which will develop later.

Having thus observed the principal natural features of the canal route, we may note to what extent the topography was affected by the French operations, paying but little attention to the period from 1889 to 1904, for the New Panama Canal Company did only enough to hold the charter.

As already noted, the French canal was excavated from Colon through the lowlands on the easterly shore of Limon Bay, and as far as Gatun it was later used by the Americans for carrying materials to the locks. It was partly excavated as far as Bohio, a total distance of about 17 miles.

The bottom width of the canal was not over 72 feet, and the depth of water averaged about 20 feet for half the length, and over the part toward Bohio where the ground was higher, did not go below sea-level. The canal crossed the Chagres River at several points, and the river water flowed freely into the canal. At Gatun, where the canal leaves the river bed, about one-third of the flow continued through the canal. The large bend in the river is "short-circuited" by a cut-off known as the Chagres diversion. There were also a number of other such diversions. At Bohio considerable rock excavation was done after the sea-level canal was given up in favor of a lock canal. From Bohio to Bas Obispo the canal excavation cut the course of the Chagres a great many times. Across the Continental Divide the French cut a comparatively narrow trench, which at its deepest point was 165 feet below the original surface, and left about 190 feet more of cut to accomplish a sea-level canal, and over 100 feet for the French lock canal. On the Pacific end a partial channel was dredged, and also the necessary diversions on each

side which captured the water from the river branches and discharged it into the bay before it could reach the canal. A total amount of 80,000,000 cubic yards of excavation was done all along the canal. Some of it was deposited on the line of the much wider canal finally adopted by the Americans, and required re-excavating; some of the channels were partially filled by silting. Besides excavation, the French left behind them some 2000 buildings and a vast amount of equipment. Much of it was overgrown with a dense jungle during the 15 years of inactivity, and was lost until years after.

THE CHOICE OF TYPE.

With this brief excursion across the Isthmus, observing the various natural and artificial features of importance, and which an examination of the maps will aid in fixing in the mind, we are in a better position to consider the problems that confronted the United States when it was necessary to decide on the type of canal. The choice lay between a sea-level and a lock canal. The United States was determined to have the best canal regardless of cost or trouble. The French ideal was a sea-level canal which they epitomized as the "Straits of Panama." But their financial resources would not allow them to attain their ideal, so they adopted a lock canal as a makeshift and temporary expedient. Knowing this, the American tendency was to regard the sea-level canal as something more difficult to attain and, therefore, as something more valuable and more desirable. Furthermore, the average citizen or average official is unfamiliar with locks, and these devices convey to him an idea of something vague and hazardous. These feelings had first to be overcome before the nation was ready to consider the question on its true merits. In view of this, of the vital necessity to the success of the enterprise of deciding the question of the type of canal correctly, the President appointed an International Board of Consulting Engineers to advise in the decision as to type and probable cost. The board was presided over by a retired major-general of the United States Army, and included in the membership seven American and five foreign engineers, all most eminent in their profession and experienced in the problems involved in the construction of the canal.

The divided report of the board was unexpected and in a way, disappointing. Five of the American engineers favored the lock type, but they were in the minority, as the chairman, the two remaining American engineers, and all the five foreign engineers voted for the sea-level canal. Five members of the Isthmian Canal Commission and the chief engineer approved and recommended the lock canal, while the other member favored the sea-level type. On a poll of individuals of both bodies, nine were for the sea-level, and eleven for the lock canal. It remained for the Secretary of War and the President to consider, with the various reports of facts and statements of relative advantages and disadvantages before them, which type was to be adopted.

The essential facts regarding the two types of canal can be most clearly set forth in a table such as the following, to which is added a third column showing the characteristics of the canal as actually built:

COMPARATIVE DATA

Sea-level canal and lock canal as proposed by the Board of Consulting Engineers, and canal as built.

	Sea-level canal	Lock canal 85-foot summit	Lock canal as built 85-foot summit
Estimated cost	$247,000,000.00	$140,000,000.00	$375,000,000.00*
Depth	40 feet	40 to 45 feet	40 to 45 feet
Bottom width	1000 feet, none 800 " " 500 " 5 miles 300 " 4 " 200 " 19 " 150 " 21 "	1000 feet, 19 miles 800 " 4 " 500 " 12 " 300 " 7 " 200 " 7 " 150 " none	1000 feet, 16 miles 800 " 4 " 500 " 22 " 300 " 8 " 200 " none 150 " "
Total volume of water within limits of canal in cubic yards.	100,664,000	303,600,000	
Number of pairs of locks	1	6	6
Dimensions of locks in feet	1000 x 100	900 x 95	1000 x 110
Highest current, miles per hour.	2.6	Inappreciable	Inappreciable
Time to complete	12 to 20 years	9 years	9 years
Dams	Gamboa in upper Chagres valley	Gatun, Pedro Miguel, Balboa	Gatun, Pedro Miguel, Miraflores

* Includes sanitation, civil government, land damages and purchase price from French, not included in first two columns.

Not only was the sea-level canal of inferior dimensions and greater cost, but its winding channel was not conducive to good navigation, and the time which a vessel in the high-level canal would lose in the locks would be lost in the sea-level canal in slowing down for passing other vessels on account of the very

narrow channels; in fact two vessels of any size could not pass in the 21 miles of 150-foot width unless one of them tied up in specially provided turnouts. The sea-level canal was not considered superior from the standpoint of safety; the sinking of a single ship could block the canal indefinitely; the many stream diversions along the banks of the canal and the great dam at Gamboa were potential sources of danger in time of flood to a canal which was in the lowest part of the valley.

It is illuminating to read the following extract from the comment of Secretary of War Taft, on the report of the Board of Consulting Engineers:

When I visited the Isthmus a year and a half ago and went over the site and talked with the then chief engineer, I received a strong impression that the work of construction upon which the United States was about to enter was of such world-wide importance and so likely to continue in active use for centuries to come, that it was wise for the government not to be impatient of the time to be taken or of the treasure to be spent. It seemed to me that the sea-level canal was necessarily so much more certain to satisfy the demands of the world's commerce than a lock canal that both time and money might well be sacrificed to achieve the best form, and this feeling was emphasized by reading the very able report of the majority. But the report of the minority, in showing the actual result of the use of the locks in ship canals, in pointing out the dangers of so narrow and contracted a canal prism as that which the majority proposes, and in making clear the great additional cost in time and money of a sea-level canal, has led me to a different conclusion.

We may well concede that if we could have a sea-level canal with a prism from 300 to 400 feet wide, with the curves that must now exist reduced, it would be preferable to the plan of the minority, but the time and the cost of constructing such a canal are in effect prohibitory.

I ought not to close without inviting attention to the satisfactory character of the discussion of the two types of canal by the greatest canal engineers of the world, which insures to you and to the Congress an opportunity to consider all the arguments, pro and con, in reaching a proper conclusion.

The following is the essential part of the decision by President Roosevelt, dated February 19, 1906, which with the reports of the board he transmitted to Congress:

It must be borne in mind, as the Commission points out, that there is no question of building what has been picturesquely termed "the Straits of Panama"; that is, a waterway through which the largest vessels could go with safety at uninterrupted high speed. Both the sea-level canal and the proposed lock canal would be too narrow and shallow to be called with any truthfulness a strait, or to have any of the properties of a wide,

deep water strip. Both of them would be canals, pure and simple. Each type has certain disadvantages and certain advantages. But, in my judgment, the disadvantages are fewer and the advantages very much greater in the case of a lock canal substantially as proposed in the papers forwarded herewith. . . .

The law now on our statute books seems to contemplate a lock canal. In my judgment a lock canal, as herein recommended, is advisable.

On June 27, 1906, Congress passed a joint resolution which approved the lock canal proposed by the minority, and finally closed the case. This was more than one year after the appointment of the Board of Consulting Engineers. Many details as well as many problems of importance were not finally determined by the board and required consideration by the Isthmian Canal Commission. It will not be necessary to describe the detailed processes and the steps by means of which these matters were finally determined, except incidentally when studying some of the important elements of the canal. A general account of the canal as it is actually being built will now be given, to be followed by descriptions of its important parts.

GENERAL DESCRIPTION OF THE CANAL.

The sea-level approach channel from the Caribbean Sea lies within Limon Bay for 4½ miles. (See plan No. 2.) It is 500 feet wide on the bottom, with side slopes of one vertical to three horizontal, and having a depth of 41 feet below mean sea-level. (See plans Nos. 4 and 5.) The range of the tide is about 2 feet. The alignment is straight for 5½ miles from the entrance as far as the Mindi Hills, at which point the American canal intersects the comparatively insignificant old French canal. There is a slight bend of long radius at Mindi Hills, and then a straight run of 1½ miles to Gatun Locks. We have passed from the valley of the Mindi River into the valley of the Chagres, and are face to face with one of the great problems of the canal construction, namely, the handling of the torrential Chagres River. After weighing several other schemes, that finally adopted consists of the formation of a lake measuring about 24 miles on the canal axis from Gatun to Bas Obispo. The length of the lake in the other direction will be over 30 miles. The lake is formed by the construction of an earth dam of unusual dimensions extending across the valley at Gatun. The dam does not seem artificial to the eye,

but appears as one of the major features of the landscape. After the lake is filled, the flow of the Chagres into it will be discharged by the carefully designed concrete spillway, which cuts through the middle of the great earth dam at a point where a rocky eminence afforded a safe location. The normal water-surface of Gatun Lake will be 85 feet above mean sea-level, but provisions are made so that the water-surface can be carried at any elevation between 80 feet and 87 feet.

Ships will be passed into Gatun Lake by means of a series of three locks at Gatun, each of which in turn will raise the vessel an average of 28⅓ feet. The locks are close together and the ships will pass directly from one lock into the next. The three locks are in duplicate; that is, a vessel may go up either one flight or the other of the duplicate locks, or one flight may be used for ascending vessels and the other for descending vessels. The corresponding locks adjoin and there is only a dividing wall between them. After the ship has passed into the lower lock, and while it is being raised, the following ship, if close behind, may be tied up at the approach wall 1200 feet long, formed by an extension of the dividing wall. Each lock has a net or usable length of 1000 feet, and a net or usable width of 110 feet, but the dimensions of the ship must be somewhat less than this to provide for clearances.

The formation of the lake with the water 85 feet above the sea-level obviated all digging for 17 miles, except the top of an occasional mound. (See plan No. 5.) The alignment of the channel in the lake was determined by the position of hills, changed into islands by the rising water.

At the locks, the canal axis makes a slight bend to the left and the channel of 1000 feet width and 75 feet depth extends in a straight line for 3½ miles to the first bend in the lake. This bend is followed by a straight channel of the same width but reduced depth for a distance of 4½ miles, almost to Bohio, where a further turn to the left is made. The course does not run straight to Bohio from the locks, because Tiger Hill and Lion Hill are in the way. After a two-mile run from Bohio to Buena Vista, 1000 feet wide, there is a turn to the right, the course continuing straight for a distance of 2½ miles to a point opposite Frijoles. Here there is a further turn to the right, with a straight course of 2½ miles, still 1000 feet wide, to a point near Tabernilla; then

a turn to the left, with a reduction in width to 800 feet, and a straight reach of 3 miles to a point near San Pablo. The lake has now become a narrow arm, occupying the region where the valley of the Chagres had much steeper banks. At San Pablo there is a turn to the left with a short run 800 feet wide of one mile; then a turn to the right, another short run of 1 mile, with a further turn to the right; then a longer reach of 3 miles, with width reduced to 500 feet, passing the submerged town of Gorgona; then a right turn and a 1-mile run to a point near Gamboa. From Gatun to Gamboa there are 23 crossings of the former course of the Chagres, showing that the canal has practically followed the course of the river, but with the aid of steam shovels has selected a much straighter course than the one carved by the river along the lines of least resistance.

At Bas Obispo, which is close to Gamboa, we enter the great Culebra Cut. The minimum width of the canal up to this point has been 500 feet, but through the following 8.1 miles the bottom width is reduced to 300 feet to save excavation. The banks of the canal become higher and higher as we pass on, until at Gold Hill, the elevation of the highest land on one side is 554 feet above sea-level, and the other side, 410 feet, while the land over the center of the canal was formerly 312 feet above sea-level, or 227 feet above the bottom of the canal. The minimum depth of the canal on the entire upper level is 45 feet at normal lake-level, or 40 feet at low lake-level, but throughout Gatun Lake the depth is in excess of these. The Culebra Cut and the 85-foot elevation of the water both end at the Pedro Miguel Lock. In passing through the cut, from Bas Obispo to Pedro Miguel, there are eight straight reaches connected by easy curves, three to the right and four to the left. It is most remarkable that so large a portion of this run is on straight lines, and that the total degree of curvature has been kept so low.

At Pedro Miguel there is one lock in duplicate which lowers the vessel to the 55-foot elevation of Miraflores Lake. The Pedro Miguel Lock has approach walls formed by 1200-foot extensions in both directions of the dividing-wall between the locks. Miraflores Lake is comparatively small, and a run of 1½ miles, in a 500-foot channel 45 feet deep, takes the ship to Miraflores. At this point there are two locks in duplicate, with approach walls at the upper and lower levels, the same as at

Pedro Miguel and Gatun. The two locks at Miraflores lower the vessel to tide-water, a drop of 45 feet at high tide, or 65 feet at low tide. (See plan No. 3.) The 20-foot tides on the Pacific coast have made the problem more difficult than on the Atlantic coast, where the tide is only 2 feet. One-half mile beyond Miraflores Locks the canal makes a turn to the right and extends for a distance of 2½ miles to Balboa, where it makes a turn to the left and extends for 4½ miles to deep water in the Bay of Panama. The Pacific sea-level section is all of 500 feet width, and the depth of the water is 55 feet at high tide and 35 feet at low tide, and is usually stated to be 45 feet deep, referring to mean tide.

The total length of the canal, measured along its axis, is 50.4 miles. The portion within the shore lines is only 41.5 miles, and the remainder consists of dredged channels in Limon Bay and Panama Bay. Of the total length, 14½ miles are at sea-level, over 23½ miles in Gatun Lake, nearly 3 miles in the locks or alongside approach walls, 1½ miles in Miraflores Lake and 8 miles in the Culebra Cut. In the total length there are 22 bends, with a total curvature of 600 degrees and 51 minutes. The average length of the straight reach is a little over 2 miles. At each bend the canal is widened by cutting away on the inside of the bend, the shape and amount of cutting having been determined after observations of vessels actually rounding turns.

The time required for a vessel to pass through is estimated to be from 10 to 12 hours, of which 3 hours is required for passing the locks. Through the Culebra Cut the vessel must reduce speed, but for most of the remaining distance may approach full speed.

GATUN LAKE.

Less attention, it is believed, has been paid to Gatun Lake by those describing the canal than the subject really deserves. (See plan No. 1.) It forms the preponderant element in the American project. The great dam at Gatun, the spillway, and the locks are only incidental to the lake, and by virtue of it the amount of excavation and the attendant difficulties in the Culebra Cut are greatly reduced.

The lake provides 23½ miles of canal channel, or nearly half the total length, and gives a width of 1000 feet for 16 miles, 800 feet for 4 miles, and 500 feet for the remaining 4 miles; the

average width is nearly 900 feet, while the rest of the canal averages less than 450 feet. Not only in width, but also in depth the lake channel offers an advantage, for while the rest of the channel is limited to an ample depth of 45 feet, the lake offers a maximum depth of about 75 feet, and is nowhere less than 45 feet along the navigable channel. These generous dimensions will facilitate navigation and will allow vessels to approach their ocean speed.

Besides being such a valuable asset to navigation, Gatun Lake solves one of the most difficult and most vital of all the problems involved in the canal construction. We are familiar with the characteristics of the Chagres River. This wild and variable stream is immediately tamed and calmed on entering Gatun Lake. Its waters, which form and replenish the lake, may be likened to a beast of burden quietly carrying the ships to and fro, supplying the lifting force that passes them through the locks, and the power to drive the generators which light the canal, operate the machinery, and may later operate the railroad.

While great ideas and great accomplishments may be briefly abstracted in picturesque terms, the knowledge so given is superficial if unaccompanied by a more intimate consideration of the principles involved, and of the studies and investigations which attended them. Nothing may be left to surmise or conjecture, no assumptions may be made, unsupported by masses of the best evidence available. Where the problems are new and no direct evidence can be obtained, the best engineering judgment, based on experience, must be brought into play.

An investigation had first to be made as to the sufficiency of the water-supply. The lake, once it is formed, will suffer losses from at least five different sources: 1st, evaporation; 2d, seepage, or groundflow; 3d, leakage through the lock gates and spillway gates; 4th, water required to pass ships through the locks; and 5th, water to develop power, if a sufficient amount remains available.

Evaporation depends on the wind and the hygrometric state of the air, and also on the area of the lake. At the normal elevation of 85 feet above sea-level, the area of the lake is 163 square miles. For certain reasons that will be discussed later the elevation of the lake may, when actually placed in service, vary from 80 to 90 feet above sea-level, and the area of the lake will vary

correspondingly from 153 to 173 square miles. Evaporation continues from day to day, and unfortunately is the greatest when rainfall is the least. The length of the dry season is therefore of importance. To provide for the driest future year, the weather records as far back as available are studied, and the driest year taken as a standard, with an allowance for even more unfavorable conditions. Fortunately, the French under the New Company made continuous and careful observations of all meteorological and hydrological features of value. The Americans have continued these observations with great care and completeness. Evaporation pans have also been exposed to secure direct evidence which would bear some relation to the rate of evaporation from the lake. From the best evidence available, the probable rate of evaporation is found to be about one-fourth of an inch per 24 hours. This has been computed to equal a loss of 930 cubic feet per second.

The loss by seepage is dependent on the character of the soil forming the bottom of the lake, and of the head or pressure of water at any particular point. To clearly understand its character we may note that an ordinary river in reality includes more than the flowing water which is visible between its banks, in that the ground along the river contains water which to the eye seems quiescent, but which actually has a flow, extremely slow, but always moving toward the river and down the valley with the river. Its rate of flow depends on the character of the material, the frictional resistance, and the distance to be traveled; it is comparatively rapid in sand or gravel, and is reduced to a minimum in clays and rocks. The seepage from Gatun Lake will be of an allied nature, and it remains to estimate the amount. The engineers made careful studies of the bottom of the lake by borings, test pits, and geological surveys. Specially careful examinations were made at those points where the ridges between the lake and the adjoining valleys are narrow and low. It was perfectly possible that gravel strata or porous coral deposits might exist which, communicating with the sea, might discharge the waters of the lake as through a sieve. The engineers satisfied themselves that no such condition existed, and their judgment was confirmed by a Board of Consulting Engineers appointed in 1908 by President Roosevelt. The probable seepage was estimated to be 85 cubic feet per second, or less than one-tenth the rate of evaporation during the dry season.

The loss of water through leaks and imperfect seatings in the many valves and miter-gates of the locks, and the 14 gates of the spillway, depends on the accuracy with which the devices are made, and the care used in the maintenance. The commission followed correct principles in using the utmost care in designing and constructing them, and yet assuming a rather heavy loss of water from incomplete closure or accident. The amount lost is estimated to be 275 cubic feet per second, the equivalent of 100 city fire streams.

The amount of water found necessary for developing electric current for lighting the canal, and operating all the machinery, is estimated at 275 cubic feet per second, based on the required amount of current and the efficiency of the apparatus.

The amount of water required for lockages is dependent on the design of the locks, the amount of traffic, and the size of the vessels, for the locks are so divided that small vessels may use short sections, or several small vessels pass through the whole lock together. Assuming the traffic equal to the maximum capacity of the locks, and utilizing records of experience with the Sault Ste. Marie Canal, the Board of Consulting Engineers estimated the traffic at 80,000,000 register tons per year, as against 30,000,000 tons for the "Soo" Canal, and an actual maximum of 15,500,000 tons for the Suez. The amount of water required for lockage was found by the designing engineers to be 2618 cubic feet per second, which means about one lockage in each direction per hour, but the assumed maximum traffic will not be reached for many years.

Adding the total losses from all causes gives a total of 4183 cubic feet per second, applicable during the dry months, when evaporation is the greatest. The question now arises: Where is this rather enormous quantity of water coming from? The input into Gatun Lake comes from rainfall directly on the lake, which is absent in the dry season, however, and from the flow of Chagres River and of minor streams. The data desired for this purpose pertains to the driest period that may be reasonably expected, and the best way to predict it is from records of the flow of the Chagres in past years. The records of the New French Panama Canal Company furnish much reliable information, while that obtained from the old company is fragmentary and incomplete.

The driest consecutive four months in the available records of 19 years show a flow on an average of 1190 cubic feet per second into the lake. Unfortunately, a 19-year period is hardly sufficient to determine the future probable minimum, and the average of 1190 cubic feet which occurred in 1908, the year the computations were made, was followed in 1912 by an average flow for four months of less than 900 cubic feet per second, or about 25 per cent less. This will not affect the problem adversely, because of the liberal allowances made in determining losses and the possibility of using the Miraflores oil-fired steam plant in place of water-power.

It is apparent that the 1190 cubic feet per second supplied to Gatun Lake will not provide the 4183 cubic feet per second to be consumed. The balance, or 2993 cubic feet per second, will be obtained by filling Gatun Lake to a level of 87 feet above the sea (the gates and copings are 92 feet) before the end of the rainy season, and then during the succeeding dry season, drawing the lake down gradually to a level of 80 feet above sea-level, if need be. The storage capacity of the lake between these two levels, at an average area of about 159 square miles, will supply this amount of water with a slight margin. The problem is identical in many respects with that involved in the great impounding reservoirs of modern city water-works, such as those of Boston and New York, where storage tides over the dry season.

It may be noted that this drawing off of the upper 5 feet of the lake explains one reason why the depth of channel through the Culebra Cut was made 45 feet at normal lake level. The water level in the cut is the same as in the lake, and when the lake falls to 80 feet, the channel in the cut will have 40 feet depth of water.

At this point it becomes clear that one of the greatest responsibilities of the canal operating force will be the conservation of the water. The operator must be thoroughly versed in problems of rainfall and hydrology, and should begin the dry season with a full lake, and he must be careful not to be caught by an unexpectedly early or unusually dry season; he must each year be prepared for the worst. No apprehension need be felt that the water-supply will give out, however, if reasonable care is taken. Should more water be required to meet new conditions of the distant future, it may be obtained by building a reservoir on the upper Chagres, with a dam at Alhajuela, where some of the flood-

waters of the Chagres may be stored until needed in the dry season. It was here that the French proposed building a reservoir for supplying the highest level of their canal through a tunnel.

We have seen that Gatun Lake can be kept full, but have yet to determine that it can be filled initially. An examination of the records of flow of the Chagres for all available years leaves no doubt that the water in the rainy season in excess of all losses is more than sufficient to fill the lake in two successive years. The driest rainy season of record, 1911-1912, afforded an average flow of 6556 cubic feet per second, which would have filled Gatun Lake in about 400 days, or two rainy seasons, making deductions for reduced losses on account of there being no lockages, no hydraulic power plant in operation, and less evaporation, leaks and seepage, due to reduced lake area and head of water.

THE GATUN DAM.

The Gatun Dam, which made Gatun Lake possible, is the key to the American Panama Canal scheme. (See plan No. 2.) The lock-level canal might have been built with a dam at a different location, such as that proposed by the French at Bohio, but the area of the lake would have been very much less, with a consequent loss of opportunity to navigate in wide, unrestricted channels, and a great loss in storage capacity. The dam at Bohio could have been built of masonry on a rock foundation, for which the French made considerable excavation. A masonry dam on rock foundation was not possible at Gatun, because the rock is too far below the surface. It was only after advice had been obtained of some of the ablest engineering talent in the world, familiar with similar problems elsewhere, that an earth dam at Gatun was decided on. This decision was probably the most momentous one in connection with the canal construction. Elaborate investigations were made of the character of the underlying material through test pits and innumerable borings. It was found that the top layer consisted of fine sand intermixed with a large proportion of clay, which extended to a maximum depth at one point of practically 80 feet. Below this, for a distance of 100 feet or more, is a thick deposit of impervious blue clay, containing a little sand with a quantity of shells interspersed. Below the clay, and directly overlying the bed rock, is a miscellaneous layer of variable thickness up to 20 feet, consisting of boulders and gravel consolidated with finely divided clays and silts.

Several important factors enter into the design of this dam and the determination of its dimensions. The dam itself must be impervious to water, or on finer analysis it would be more accurate to say the seepage must be a minimum. If a well, extending below the ordinary level of the ground water, and without tapping subterranean water channels, is pumped, the ground water in the surrounding territory will flow towards the well and its level will gradually fall and assume a curve joining the surface of the water in the well with the normal ground-water level some distance away. The slope of this curve depends upon the character of the material and the amount of friction which it exerts against the flow. Deeper pumping will lower the curve and extend it farther back. To maintain a fixed level of water in the well will require a fixed rate of pumping, equal to the seepage through the ground, so long as no rain falls on the area affected by the well. The conditions at the Gatun Dam are similar, with the ground-water level in the valley below the dam corresponding to the water in the well and the water in the lake corresponding to the normal ground-water level, and the slope curve passing through the dam.

To prevent loss of water, the materials of which the dam is built must be selected from the available local deposits and placed in such a way as to retard to the greatest possible extent the flow of water. In very fine silts the rate of flow is so minute that they are generally classed as impervious. Capillary attraction is a force which must be considered. It is this which keeps the surface of ordinary ground moist. The evaporation from the surface removes the moisture, but it is promptly replaced by capillary attraction from the ground-water reservoir below. With no rain the ground water is thus gradually lowered until the capillary forces are no longer sufficient to raise the water to the surface, which then becomes dry. This force must also be considered, although to a minor extent, in the design of the dam.

Unfortunately, the ordinary materials which are classed as impervious have a faculty for absorbing water, which softens them and reduces their capacity for self-support. With the height of water furnished by Gatun Lake there is ample opportunity for the contents of the dam to become saturated, and materials subject to disintegration, or with a tendency to absorb, would not maintain the side slopes. Clay or fine silt is particu-

larly treacherous in its nature; yet it is upon these materials that the imperviousness of Gatun Dam must depend. The solution of this problem is to build the center of the dam of impervious material and the outer portion on both sides of a material capable of maintaining the predetermined slopes wet or dry, but necessarily allowing water to pass. On the lake side it must be faced with a lining to resist wave action.

Yet this is not all. The weight of the dam might produce so great a pressure on the original surface of the earth that it would sink and cause the earth to rise just beyond the toe of the dam. This actually happened only a short distance away with embankments for the Panama Railroad. The remedy was to counterweight the rising area of soft material at the toe of the embankment with fill material and thus prevent any further rise. With a structure like the Gatun Dam, settlement of this character would have dislodged the parts of the dam already built, would have created possible fissures and avenues for future flow, and would have aroused the greatest doubt in the minds of the public as to its strength and safety; therefore, the question must be investigated and settled in advance. The rising of the material is prevented by first removing any soft material, and further by making the dam very wide, with a thin extended toe, thus making the counterweight a part of the dam itself. Even with the greatest precautions a slip in the rock fill due to giving way of soft material near the old French canal occurred and caused great popular alarm, and led the President to order a board of eminent engineers to Panama. Their report was most reassuring and confirmed in the main the judgment of the commission.

Not only the dam itself, but also the material upon which it is built, must prevent the water from flowing underneath it. To increase imperviousness, the commission drove a line of sheet piling twenty feet into the earth; but on the advice of the special board of engineers this was omitted and, instead, a trench was dug along the middle, which was filled by the core of the dam.

The generous dimensions of the dam, however, principally contribute the imperviousness and stability. As finally built the crest is 100 feet wide and 20 feet above normal water-level; the thickness of the dam at the water-surface is 400 feet, and it increases to a thickness of nearly one-half mile at its deepest part.

The dam, after clearing the 573 acres of site, was constructed

by first building long mounds along the outer lines of the dam with the proper exterior slope. The material was spoil from the Culebra Cut, the locks and the spillway, and was dumped from trestles. When the mounds were carried to sufficient height, the interior space was filled with silty material from nearby deposits by the hydraulic dredging process. Where the course of the Chagres crosses the dam two lines of sheet piling were driven, and the material between them, which was not of a suitable character, was excavated and replaced.

The design of the Gatun Dam was not decided on until elaborate tests had been made of the actual seepage through the material to be used in the construction. These seepage tests were made by drilling holes into the deposits that were later to form the core of the dam, and pumping a measured amount of water into them and noting the loss and rate of flow under fixed pressures. The natural flow of the ground water through the soil was also studied. Several model dams were built and experiments made to determine the slope of the water through the material of the dam, caused by the minature lake on one side. Test pits were dug in the deposits, and the flow into the test pits was pumped out and measured, while at the same time observations on the level of the ground water were taken in the neighborhood.

The dimensions of the cross-section of the dam were twice changed. The height of 135 feet above sea-level, as originally proposed, was at first reduced to 115 feet, and finally to the adopted height of 105 feet. The surface slopes and width at the bottom were also changed.

GATUN SPILLWAY.

During the rainy season the influx of water into Gatun Lake will be much greater than the amount consumed, and the spillway through the Gatun Dam provides the outlet. It might have been placed anywhere on the rim of the lake and a channel to the sea constructed, but a favorable site on rock foundation was found on the line of the dam, which allowed the use of the bed of the Chagres for carrying the water to the sea. (See plan No. 2.)

The spillway consists of a concrete dam with means for overflow, and a concrete channel to lead the water away. It is a

most important adjunct to Gatun Lake, for it not only will safely relieve the lake of dangerous flood-waters, but also will control the level of the water-surface, thus accomplishing the storage of a part of the flood-waters for use in the dry season. Its discharge capacity must be made equal to that of the greatest possible flood. To determine the amount of water, we must again seek information in the records of the New French Company and the succeeding records by the Americans. It is to be deplored that the old company obtained no record of the Chagres flood of 1879, known to be larger than any covered by subsequent records. The engineers' report states that, "The maximum momentary discharge of the Chagres River at Gatun is calculated from the measured Bohio discharge to be 182,000 cubic feet per second." This is over 200 times the minimum dry-weather flow.

An overflow type of spillway to carry off this amount of water would be over 2,000 feet long, and even so its discharge capacity at the highest floods would not be sufficient, and the lake might rise five feet. For these reasons the commission adopted a spillway with a crest that is semicircular in plan and has fourteen openings cut through the upper part, closed by gates. The elevation of the bottom of the openings is at 69 feet above sea-level, or 16 feet below the normal level of the lake. Each opening is about 45 feet wide. They are so wide, in fact, that the top of the spillway is really composed of a series of piers, with the openings containing the valves between them. When the gate is shut, its top is at elevation 88 above sea-level, making the gate 19 feet in its vertical dimensions. The gate may be raised 22½ feet, or clear of a 90-foot depth of water in the lake. This device for discharging water from the lake is far superior to the plain crest without gates, because the amount of water passing through may be very nicely controlled; furthermore, any increase in the depth of the water in the lake from sudden floods would tend to increase the capacity of each opening of the spillway, because the amount of water discharged through a weir is dependent upon the head or elevation of water which is acting on the weir.

When the lake is at elevation 87 a single gate will discharge 11,000 cubic feet per second, or 154,000 cubic feet per second for the lot. The maximum known flow of the Chagres is less than this amount; in fact, is only 137,500 cubic feet for any prolonged period, such as 33 hours. The momentary discharge may be

Photos by Underwood and Underwood, New York.

FIG. 1.—The canal, looking north from Empire in 1885, under French control.

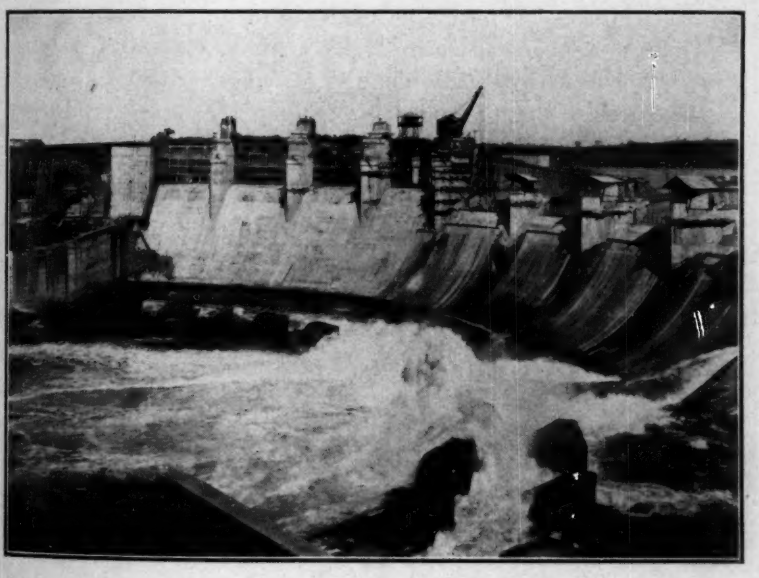


FIG. 2.—Gatun Spillway Dam, showing three permanent crest gates in position. January, 1913. The water is issuing from temporary culverts, to be later permanently closed.

much greater than this and has been determined as high as 186,000 cubic feet per second, but, in designing a spillway, the momentary maximum is not what is wanted. Should any flood occur which will exceed the capacity of 154,000 cubic feet per second, then, of course, the lake will begin to rise; but as it rises, the capacity of the spillway is increased until, with the lake at the improbable elevation of 92 feet, above which the water would flow over the miter-gates and into the locks, the rate of discharge of the crest will be 222,000 cubic feet per second. In addition to this, water can be passed through the lock culverts both at Gatun and Pedro Miguel. The length of the period over which records of flow of the Chagres are available is insufficient to predict with any degree of certainty the probable maximum flood at some future time, and the commission has again shown its wisdom in designing for a capacity which is quite far in advance of that required by recorded floods.

The gates themselves are constructed of heavy and massive steel work. They are of the so-called Stoney gate-valve type. The sliding frictional resistance of ordinary valves of this size would be very great. The Stoney pattern of valves overcomes this by using roller trains upon which the valve travels. Passing lengthwise along the dam and underneath the gates is a tunnel in which all the machinery for operating the gate valves is placed. A chain is fastened to each side of the gate and passes over a sprocket-wheel on the adjoining pier, and then down through a vertical well to the machinery tunnel. A large screw is fastened to the end of the chain and passes through a worm. A heavy counterweight hangs on the lower end of this screw rod, leaving only frictional resistance to be overcome. The motor for operating the worms is located midway between the screw rods, thus applying equal lifting force to each end of the gate.

After passing over the crest the water slides over the face of the spillway, which is so designed as to fit the normal curve of the water. At the bottom the concrete work is curved so as to give the stream a horizontal direction. About 21 baffle piers are built within this area to retard the rapid flow. At the same time, the channel becomes contracted from a width of 414 feet, which is the length of the inside of the crest, to a width of 285 feet. The water is carried in a long sluice-way, lined with heavy concrete walls and paved with a concrete floor, and is discharged at

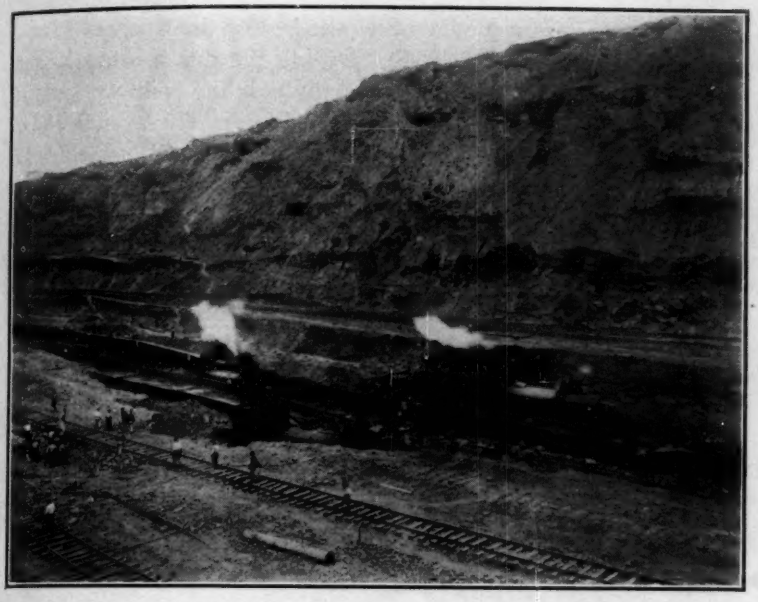
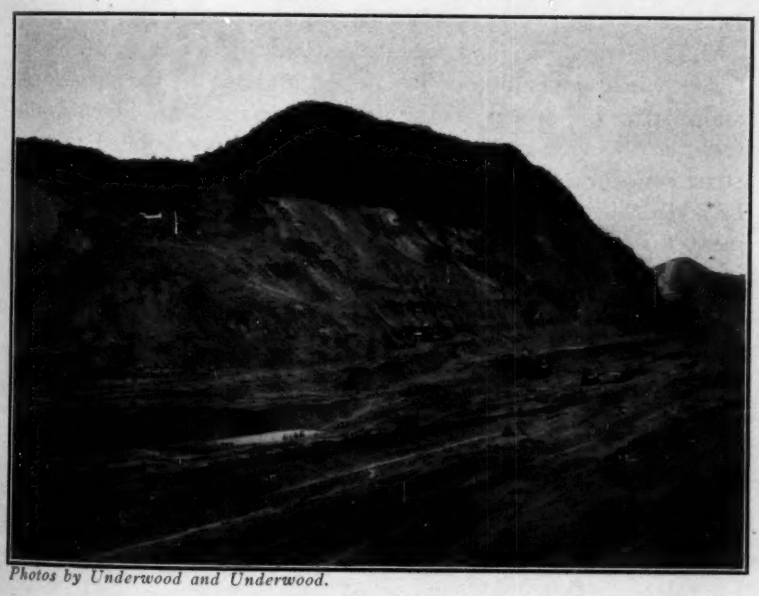


FIG. 3.—Culebra Cut, Culebra, showing steam shovels working at elevation +73. Looking east, January 27, 1912.



Photos by Underwood and Underwood.

FIG. 4.—Culebra Cut, Culebra, showing break in east bank of canal. Amount of material involved, 320,000 cu. yds. February 11, 1912.

a safe distance from the dam into the bed of the Chagres River, whence it continues to the sea. During the dry season of four months very little water will pass through the spillway, but in the rainy season varying amounts will pass. The average flow will be about 10,000 cubic feet per second, increased momentarily to almost 15 times that amount during periods of high flood. Over the tops of the piers which separate the gate openings a bridge and roadway have been built, so that traffic may be carried the full length of the Gatun Dam.

So important to the success of the canal is this spillway that the commission's engineers constructed a model of the same for experimental purposes, 1/32 of the size of the original. It was tested under various conditions and the facts thus gained were of value in making the final designs.

EXCAVATION OF CULEBRA CUT.

The Culebra Cut is very generally and very justly considered the most important part of the canal construction work. (See plan No. 5). The date of completion of the cut practically determined that of the whole canal. It was in charge of the Central Division of the canal organization, which covered also the small amount of dredging and excavation within the limits of Gatun Lake. Total expenditures are a good measure of the magnitude and relative importance of the various items and are given in the table below, showing that over half the amount applied to construction work direct, was for the Culebra Cut. There might be added to the total for the Culebra Cut $20,000,000 of the payment for the French property which applied to excavation, thus indicating that the cut comprised over 55 per cent of the construction work of the canal proper.

TOTAL EXPENDITURES TO JUNE 30, 1912.

DIRECT CHARGES TO CONSTRUCTION.

	Amount.
Atlantic Division: Channel Gatun to sea; Gatun Locks, Dam and Spillway; Colon Breakwater, etc.	$43,875,000.00
Central Division: Culebra Cut	76,565,000.00
Pacific Division: Pedro Miguel and Miraflores Locks, Dams and Spillway; dredging Miraflores to sea; breakwater, etc.	31,710,000.00

EXPENDITURES NOT CHARGEABLE DIRECTLY TO CONSTRUCTION.

Department of Sanitation	$14,815,000.00
Payment to French Company	40,000,000.00
Payment to Panama Republic	10,000,000.00
Panama Railroad improvements and relocation	13,650,000.00
Steamers purchased and repaired	2,680,000.00
Zone water-works, roads and improvements	7,600,000.00
Canal Zone buildings	10,135,000.00
Miscellaneous items	8,070,000.00
Total to June 30, 1912	$260,000,000.00

A typical American tool developed largely on railroad work, namely the steam-shovel, solved one of the vital parts of the excavation problem. Its function was to pick up the soft or blasted hard material and place it aboard the cars. It performed its function so well that the rate of progress was dependent on keeping the shovels supplied with cars and disposing of the material on the dumps. Again allowing the cost of the various items into which excavation may be analyzed to indicate their relative importance, the following table, taken from the records for the fiscal year 1912, is given with the items arranged in the order of cost.

ANALYSIS OF COST OF EXCAVATING CULEBRA CUT, TAKEN FROM RECORDS FOR FISCAL YEAR, 1912.

	Cost per Cubic Yard.
1. Transportation	$0.1331
2. Drilling and blasting	0.1157
3. Tracks	0.0885
4. Loading by steam-shovels	0.0681
5. General expense and supervision	0.0503
6. Dumps	0.0479
7. Plant, arbitrary	0.0395
8. Drainage, structures and clearing	0.0045
Total unit cost	$0.5496

The clearing of the site in preparation of excavation work was of minor importance. After the loose material had been cut away by the shovels, the drilling and blasting followed. Of the total of 93,000,000 cubic yards of material removed from the cut prior to July 1, 1912, about 66,500,000 cubic yards, or 71½ per cent,

required drilling and blasting. The power for drilling was supplied by a large compressed-air main, which was tapped at convenient points and the lines laid to the drills. The work was most carefully studied and planned. Systematic records were kept of the amount drilled by each crew daily. Familiarity with the material and trial of various methods indicated exactly the setting of the holes and the depths to which they should be drilled to obtain the greatest economy. All loading of holes and firing was placed in the charge of a special crew of trained men, and the firing was done by current from the electric station at Empire. There was a serious accident during the early stages of the work, due to a premature discharge of a vast quantity of dynamite that had been placed in the holes and left there for firing at a convenient time. From some obscure cause, such as the overheating of the dynamite, it exploded and killed a large number of men. Thereafter the dynamite was fired within a few hours after being placed, with the result that in three years only eight men were killed by dynamite, although a total of 19,000,000 pounds of explosives was used in the Central Division during that time. A knowledge of the handling of explosives, as in the case of many other important public works formed an asset of great importance. Various kinds of explosives were used, including saltpeter dynamate with 60 per cent nitroglycerin, saltpeter dynamite with 40 per cent nitroglycerin and Trojan powder. The total amount of explosives used on the entire canal work to June 30, 1912, reached the enormous total of 50,000,000 pounds. When the blasting did not break up the material small enough for handling by steam-shovel, it was further broken up by so-called "dobe" shots, which consisted in laying a small stick of dynamite on the top of the rock and detonating it with a safety fuse.

The shovels worked on short pieces of track, which were extended as the work progressed, while the cars for receiving the material were handled on parallel tracks next to the shovel. So rapidly did the shovels load cars that the handling of dirt trains into and out of the cut was a problem in railroad transportation of the very first order. Within the limits of the cut there were nine parallel tracks to carry the traffic, having a total length of over one hundred miles. Where two or more shovels were working on one line, the empties came in on one end of the track, so that each shovel had a train of cars. As soon as any shovel filled

Photo by Underwood and Underwood.

FIG. 5.—Culebra Cut, Empire, looking north from suspension bridge. The two shovels in the center are standing on the bottom of the canal. January 6, 1913.

its train, all were immediately shoved ahead so as to get the full train out of the way. By adhering to this system the first train was always the one to be loaded first. All trains were handled by a train despatcher and his assistants, who were located in a tower in a commanding position and provided with telephones, flags, and other forms of signalling apparatus. A great deal depended on the manner in which the train despatcher handled his work. There were empties to get into the cut over a complicated system of tracks to a proper shovel; there were loaded trains to be moved on, and loaded trains to be passed out of the cut; there were workmen's trains, accident cases, special locomotives, and other traffic to handle. There was scarcely a moment when some definite action, affecting the economy of the entire operation, was not expected of the train despatcher. The trains were passed on to the construction tracks and thence to the main line of the Panama Railroad. The dirt trains invariably had the right-of-way. To observe the work of these train despatchers, and to see the constant procession of dirt trains and empties rolling along the main line of the Panama Railroad, was most impressive. The traffic was probably equal to that on the main lines of a great many of the important trunk lines of the United States. The amount of traffic is indicated by considering the average number of locomotives and cars in use during a typical year, namely 1912, as shown by the following table:

LOCOMOTIVES AND CARS.	Average Daily Number in use, 1912.
Locomotives handling spreaders	6
Locomotives handling unloaders	10
Locomotives handling track shifters	3
Locomotives handling dirt and miscellaneous trains	117
Lidgerwood flat cars, average per day	2403
Large steel dump cars	320
Small steel dump cars	973

The largest number of cars handled in one day during the year 1912 was 4896. In other years the amount was even larger. The number of shovels in use during this year was 46, of which nearly half were 95-ton shovels with a dipper capacity of 5 cubic yards. The highest daily yardage for one shovel was 4465 cubic yards. The highest annual record was 543,481 cubic yards. The average amount of material handled per shovel per hour increased from

121 cubic yards in 1908 to 165 cubic yards in 1912. In the meantime the average cost per cubic yard of excavation dropped from $0.725 in 1908 to $0.55 in 1912.

The disposal of the excavated material required most careful thought and involved considerable engineering ability. The rate of progress on the Culebra Cut, and therefore the rate of progress on the whole canal, at various times depended upon the speed at which the trains could dispose of their loads of dirt. Where the material could possibly be of any use, trestles were built and the material was deposited without rehandling directly where it was needed, as in the Gatun Dam, the back fill behind the lock walls, the embankments of the new Panama Railroad, and in raising the level of swamp lands, making land, and building a breakwater at the Pacific entrance of the Canal. The vast bulk of the material was wasted. The principal dumps were at Tabernilla, Gatun, Miraflores, Balboa and the Panama Railroad relocation. Each of these dumps took from 5,000,000 to 18,000,000 cubic yards. Trestles were first built to dump material off the cars; and as the level of this fill rose, the track was removed from the trestle and shifted always toward the edge of the bank. It was the constant shifting of track and extension of trestles which caused the delays in disposal of material. The ingenious methods that had been developed on railroad work and elsewhere were utilized on the dumps. A small amount of the material was handled in steel side-dump cars which landed the material alongside the track. Air-pressure from a locomotive was used in dumping these cars. Another and a more ingenious method for unloading them was by means of a large plow. The cars were flat and had a bulkhead on one side only; to balance this the other side overhung slightly more. When a train arrived at the dump an enormous plow of the full width of the car, was set on one end of the train, and a cable led to the other end. The winding of the cable drew the plow the full length of the train and discharged all the material on to the ground next to the track.

A further operation was necessary, because the track could not be laid directly on the brink of the dump. The material which was piled up by the dumping of the cars was shoved off the edge of the embankment by means of an enormous plow suspended over the area alongside the track from a special car, and pushed along by powerful locomotives. When the dump had been

widened to a point where the plow or spreader could no longer slide the material out of the way, it was necessary to shift the track. Here again railroad experience was brought into play, and the work of hundreds of men was done by a small crew with a track shifter. This machine had two booms; the first lifted the track off the ground, the second was slewed, and a line passing over it was made fast to the track and drew it into its new location. The length of the booms was sufficient so that the weight of the shifter itself, which ran on the track did not affect the work.

Special problems were encountered in some of the dumps, of which one of the most interesting was the disposition of silt and clays taken from the Chagres section of the Central Division. It became very soft when exposed during the rainy season, and the slope was found to be in some cases as flat as 1 vertical to 22 horizontal. It was impossible to maintain tracks on such material. Accordingly, a track was laid along the banks of the Chagres on hard ground, and when the material was dumped it was thoroughly wetted by means of a 4-inch water-pipe, whereupon the saturated material slid slowly but firmly into the Chagres River. The current was sufficient to carry it along and deposit it at points where it could do no harm.

GEOLOGY AND THE SLIDES.

The material through which the Culebra Cut passes is very variable. The region of the Isthmus was once geologically very active, and each period of activity is marked by material typical of the conditions under which it was formed. Fortunately, as in so many other parts of the world that were once the scene of geologic or volcanic activity, the Isthmus is now in a quiescent period and the great geologic forces are in a condition of stable equilibrium. When the canal project was being agitated there was great apprehension on the part of those not familiar with conditions as to possible volcanic eruptions or earthquakes. In allaying this feeling, the photographer of the flat arch in the ruins of the old Santo Domingo convent in Panama played a very important part. The fact that the arch has stood for so many years, while the roof and windows have disappeared and the masonry has deteriorated, adds to the impressiveness. Equally important, as proving the absence of seismic disturbances, is an almost exactly similar arch in a nearby church which still carries its

superimposed floor load. Being in a different plane adds to the force of the evidence.

The comparatively infinitesimal forces controlled by the hand of man in a few localities produced minor conditions of instability that have resulted in so-called "slides" or "breaks." Fortunately man controls the means to restore equilibrium. This phase of the canal work will be more fully described later on.

From the reports of the commission's geologist it is learned that the oldest rocks are exposed along the canal from Bas Obispo, not far from the head of Gatun Lake, to Empire, about the middle of the Culebra Cut. These are of a character known as basic metaconglomerates overlain by a series of miscellaneous volcanic rocks. The whole in past ages has been under heavy stresses, which have caused faults and sheers; that is, the rocks have cracked and the parts have slid by one another vertically, and this resulted in very much broken masses. From Empire to Paraiso, at the head of Miraflores Lake, and thus including the rest of the Culebra Cut, there existed in a former age a great basin or sag. The rocks which compose the sag or downwarp are soft and friable in their layers, and consist of carbonaceous clays and shales, with intermixture of pockets of gravel, sand and marl. This basin no longer forms a valley, for during succeeding geologic periods it was filled with new formations. The carbonaceous basin rocks are overlain by the next younger formation, composed of light gray limy sandstones and sandy limestones in beds or lenses, and separated from each other by thin beds of friable shale with occasional masses of carbonaceous matter. These formations contain fossils of marine fauna which also occur at other points entirely across the Isthmus, and as these are formed only in the shallow estuaries of the sea, it is proven that the materials in which the fossils are now lodged were deposited under water; and their disposition across the Isthmus is considered by geologists as proof that the Atlantic and Pacific Oceans were joined at that time. The latest marine-deposited rock is composed of coral and shell limestones and is of non-continuous occurrence. During succeeding ages these formations slowly rose as they are now above the level of the sea. There was then aerially deposited a thick bed of greenish fine-grained volcanic clay rock, which fills the depressions in the marine-deposited rocks—the remains of probable former estuaries

and channels. This deposit is also not uniform, but contains beds of gravel, sandstone and lava flow. The whole is weak and crumbly.

The most recent geologic formations consist of masses of volcanic rock; molten lava from below, forced its way through the softer rocks along the lines of least resistance, sometimes spreading between the layers of softer rock and sometimes breaking through in great rifts, forming dikes. Great volcanic masses have also risen, due to the pressure exerted from below, and, forcing their way upward in a cold condition through several hundred feet of softer overlying rocks, are said to have formed such elevations as Gold Hill and Contractors' Hill.

The geologically recent volcanic rocks are generally hard, and they fortunately serve to greatly strengthen the banks of the canal. The various rocks are in irregular formation, and have in some cases been dislodged from their former relative position by faults or vertical sliding of unstable masses, and by the breaking and cracking into blocks of masses of contiguous rocks. The older rocks are in general of a weak character, easily crushed and weathered.

With this brief description of the local geology, the problem ahead of the engineer in planning and making the Culebra Cut becomes a little clearer. It is to be remembered that most of the information now available was unknown before the excavation exposed materials hundreds of feet below the surface. Where the canal passes through a deep cut, the exact slopes to be given to the sides are of the greatest importance. If they are too steep the material will slide or fall into the canal, and if the slope is flattened even a little, unnecessary excavation and greater cost will be incurred, increasing rapidly with the depth of the cut. The side slopes must be determined in advance of excavation, as far as possible, because the shovels in the beginning cover the full width and gradually work to the lower levels. The cutting of any additional material from the side to flatten the slope will be hazardous and costly. As the cut progressed, the bulk of the side slopes proved stable. But as already mentioned, certain areas of instability developed into breaks and slides.

The slides are a feature of the canal operations that has received perhaps more than its share of attention, and has been made use of by alarmist press agents. Whereas the amount of

FIG. 6.—A recent slide, showing shovel at work. February, 1913.

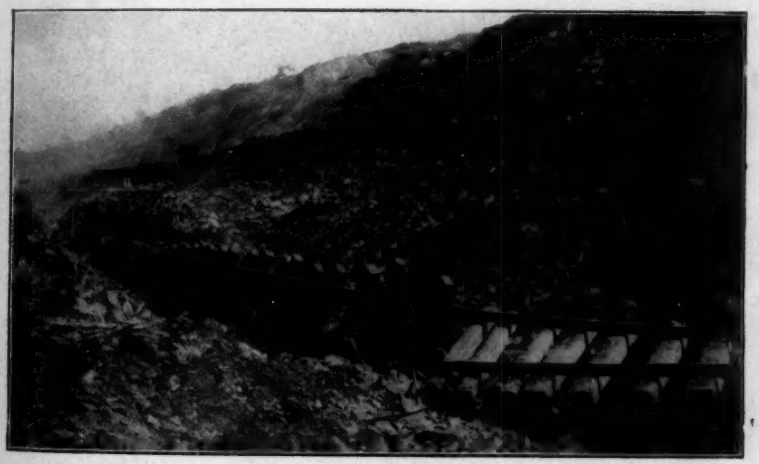


FIG. 7.—A recent slide—near view. February, 1913.

excavation for the whole canal is 212,227,000 cubic yards, the total additional amount of material to be removed, due to the slides, is estimated to be approximately 20,266,000 cubic yards, or less than 10 per cent of the total excavation, or a little over 16 per cent of the dry excavation or about 20 per cent of the excavation in the Culebra Cut. This is relatively the same condition that would be encountered on an ordinarily difficult sewer or water-pipe trench. Recent activity of the slides will increase the amounts.

The slides are not to be minimized, however, as the amount of material involved is equivalent to the excavation for 60 of the largest dry docks. Careful attention has been given them by the commission, and the geologist employed by them has made a thorough examination and report on the subject.

Slides have developed at those points where the side slopes of the canal excavation were left too steep; that is where not enough material was taken out to provide a stable bank, having in view the soft or weakened character of the material. By removing additional material, stability of the banks results and the slides are thus resolved into a problem of the ultimate amount of excavation. Very large areas are involved. The Culebra slide for instance covers 46.6 acres and involves the excavation of over 7,000,000 cubic yards. The Cucarache slide covered over 47 acres and involved over 3,000,000 cubic yards. These are the largest.

The slides are of four different characters, each due to different conditions. The first is produced where a bed of clayey materials, with or without superimposed formations, rests on a bed of harder material which pitches toward the canal. If the surface is sufficiently lubricated by the ground waters, the superincumbent mass slowly moves into the canal. The second class results where faults or great geologic cracks in the rocks occur, and where the fault is at such an angle that the material in the canal prism held the rocks from sliding and, upon excavation of this material, there is nothing to prevent a sliding into the canal. The third and most subtle and difficult form of slide, which is locally known as a break or structural break, begins by a vertical settling of the banks. Cracks form and the material between cracks settles a little more on the side toward the canal, causing the cracks to open and a series of steps to form; at the same time

the bottom of the canal rises. The rocks in which this phenomenon occurs are some of the weakest in the canal and are composed of loosely cemented rounded particles. Very little stress will break the cementitious material, and the rounded particles then flow freely on one another; there is nothing to prevent their sliding, as would be the case if they interlocked like pieces of broken stone. The masses do not slide directly into the canal, but the high part of the bank drops vertically, slides some, and forces the bottom of the excavation to rise. It reaches a state of equilibrium by a different method than the normal sliding mass. The fourth form of slide is that due to erosion and weathering induced both by physical and by chemical forces. Just as every cliff has as its foot a talus of broken bits of weathered rock, so the banks of the canal will weather, and limited amounts of material will wash into the canal. Vegetation will retard this. The rest will have to be dug or later dredged from the canal.

The serious problems of the slides will have been solved when the canal is finished. No one can predict with certainty, however, that they will have been altogether eliminated by that time. New slides may develop or old ones extend. But the slides are usually slow to develop, and the material can be rapidly excavated should any occur. The commission will no doubt leave for the maintenance force a fleet of dredges and other excavating apparatus, with which the problems could be met should they arise.

It may be added that it is most fortunate that we did not adopt the sea-level canal, for with 85 feet greater depth the slides in the cut might easily have been fourfold the present extent, and they might indeed have been a problem of the first magnitude.

MIRAFLORES LAKE.

Miraflores Lake is a very much smaller body of water than Gatun Lake, and lies between the locks at Pedro Miguel and those at Miraflores. (See plan No. 1.) It is a little over 1½ miles long and about 1½ miles wide at its widest part. It was at first intended to have the lower locks built close to Balboa instead of at Miraflores. If this had been done, the lake would have had an area of 7 square miles instead of as built, only one square mile, and would have afforded a very fine navigable channel of 5 miles, instead of only 1½ miles, as at the present time. This was the

scheme proposed by the Board of Consulting Engineers in their report of 1906. The change from the board's plan to the one finally adopted involved an increased cost of about $10,000,000.00, and was apparently disadvantageous, so far as the physical characteristics of the canal are concerned. The reasons for the change were that close to Balboa the locks would be subject to hostile gun-fire from the Bay of Panama, and that the preliminary work on the dam at Balboa connecting with Sosa Hill showed that the most suitable foundation did not exist.

The water-level of Miraflores Lake will be carried at elevation 55 feet above mean tide. Miraflores Lake occupies a portion of the valley of the Rio Grande River, and at its lower end the Miraflores locks have been constructed in the line of this valley. Dams extend from the lock walls to neighboring hills, which are close by, so as to enclose the lake. The dam on the west side of the locks makes an apparently unnecessary sweep to the south, but the object is to capture the flow of the Cocoli River for use in the lake and to prevent the water from giving trouble in the valley below the locks. The flow from the Rio Grande and Pedro Miguel rivers, and one or two other smaller streams, also enters the lake. The water from Gatun Lake which is used in the single lock at Pedro Miguel will flow into Miraflores Lake. The water consumption from Miraflores Lake is that due to evaporation and lockages through the two sets of locks at Miraflores, and the amount used will be in excess of the supply from the rivers during the dry season. The difference will be made up from water allowed to flow into Miraflores Lake from Gatun Lake. During the rainy season there may be an excess of water, and this will be discharged through a spillway having gates exactly like those for the Gatun Dam spillway. The capacity of the gates was not, however, designed from the estimated flow thus obtained, but was based on the flow which would enter Miraflores Lake in case all the gates in one of the Pedro Miguel locks should be wrecked, and the full head of water from Gatun Lake should flow uninterruptedly through one of the Pedro Miguel locks. The discharge from the spillway is into the old channel of the Rio Grande River, over which the spillway is built. After following the old channel for about one mile, the water will be carried through the Rio Grande diversion for about 1¾ miles, when it will again enter a part of the old river channel and find its way to the sea close to the mouth of the canal.

THE CANAL LOCKS.

The passage of a vessel through locks wherein it remains continually water-borne is comparatively simple, as compared with the usual process of placing vessels in dry dock, involving the removal of water from the dock and support of the ship on blocking. The percentage of accidents in both cases is found to be exceedingly small. About 90 per cent of the accidents in locking vessels is due to failure of signals from the bridge to the engine room, and these will be eliminated at Panama through the adoption of a part of the process in common use in docking; namely, the vessel will not move into the lock under its own steam but will come to a full stop at the approach wall, and the movement of the ship will then be controlled by the lock operatives. Two lines to the bow and two to the stern will be used, the strains being obtained from four electric locomotives with winches on board, running on rack railroads on the edge of the lock walls, two on each side of the lock. For large ships more lines and more locomotives may be found necessary. The process is not dissimilar to towing canal boats, but with amplifications. With experience there will no doubt be developed the proper order of seamanship to handle vessels expeditiously under these novel conditions. (See plan No. 6.)

The canal has in all twelve lock chambers, two flights of three each at Gatun, two flights of one each at Pedro Miguel, and two flights of two each at Miraflores. The twelve locks are alike in their principal features, but variations occur from differences in arrangements of gates and protective devices. The lock chamber must have at least one gate at each end, to separate it from the adjoining chamber or from the adjoining body of water. The minimum number of gates that would fulfil this condition for the arrangement of locks adopted is 18. The actual number used is, for various reasons to be explained later, increased to 46.

Each lock has a chamber 110 feet wide and 1000 feet long, but as about 95 per cent of all ocean-going vessels are under 600 feet long, the locks are divided by a second set of gates into two parts, one 400 feet long and the other 600 feet long. There is no saving of time in filling a small chamber rather than the full 1000-foot lock, since all filling is done at the rate of 2 feet per minute; but advantage in the use of divided locks arises from the

great saving in water, which is an element of importance, as we have seen in considering Gatun Lake. This feature adds ten pairs of lock gates to the installation. One duplicate lock, namely the lower one at Miraflores, is not provided with the dividing gates. This is because the designing engineers found that the cost of the gates and additional length of concrete structure in this particular lock, due to tidal conditions, outweighed the saving in water.

Should a vessel approaching the first lock of any flight not come to a stop through some misunderstanding, a collision with the lock gate will be prevented by a chain of 3-inch iron stretched from one side of the lock to the other. The impact will be taken up by hydraulic cylinders in the lock walls to which the ends of the chain will be attached. The resistance is sufficient to stop a 10,000-ton vessel moving at 4 knots per hour in a length of 73 feet. When not in use the chain will rest in a groove in the floor and side walls. If the chain should give way, or not be in position, the impact would be received by a pair of guard or safety gates, which it is expected would check the vessel and prevent it from injuring the next set of gates. Should the inconceivable accident happen of a vessel passing both the guard chain and safety gate and wrecking the next one while all the other gates in the lock were open, due to a vessel having just passed through, then Gatun Lake would begin to flow out to the full capacity of the channel now formed by the lock, and similarly for Lake Miraflores. Four guard gates are required to protect the entrances to the four lock chambers adjoining Gatun Lake at Gatun and Pedro Miguel, and four more to protect the exits from the same locks, as an accident at the exits would have the same consequences as at the entrances. Similarly, two gates each are required at the entrances and exits of the upper Miraflores lock chambers, or a total of twelve guard gates.

A guard gate is also constructed at the lower entrance of each flight of locks, and the leaves of this gate point away from the lock. Each of these gates is a guard for vessels approaching from below and also may be used in unwatering the lock.

Even the well-nigh impossible combination of circumstances described above would not wreck the canal. The mitering lock gates could of course not be closed against the flowing stream, and to stop the flow the emergency dam would be brought into

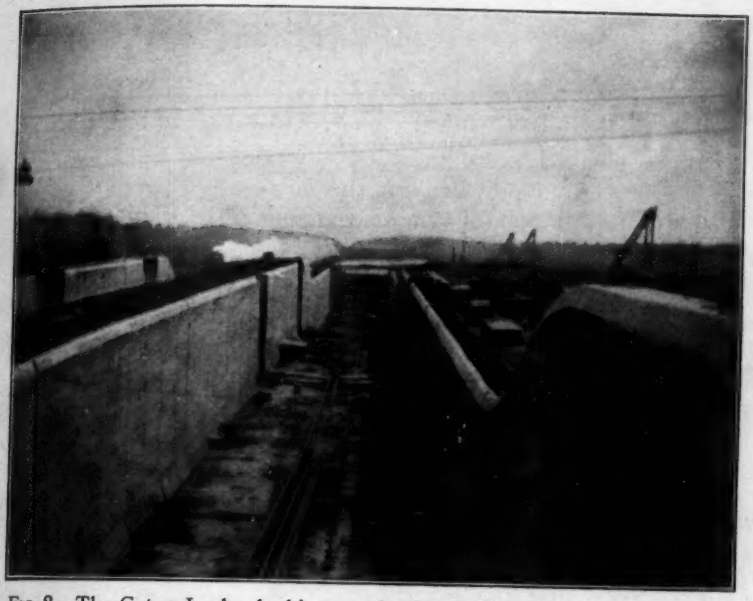


FIG. 8.—The Gatun Locks, looking north, showing temporary concrete dam at extreme lower end. April, 1912.

FIG. 9.—An emergency dam under construction, counterweight on the right. The left portion will turn to span the lock, and from it the vertical girders will be lowered, with the lower ends resting on the sill at floor of lock. February, 1913.

play. The emergency dam is in the form of a bridge resting on a turntable on the side wall of the lock. It may be turned so as to span the lock and then be firmly bedded on each side. A series of steel girders with the upper ends fastened to the bridge would be lowered by cables into position, having the lower ends on a concrete sill provided for the purpose. Then steel plates would be forced down one by one, supported by the girders, and the opening would thus be gradually closed by a steel wall and the flow practically stopped. A floating caisson such as is used with dry docks would then be placed at the lake end of the lock on a seat provided for the purpose. The caisson carries a pumping plant for unwatering the lock, and repairs may thus be made. In the meantime traffic would use the other series of locks in both directions.

The locks are some of the most massive concrete work in the world. The dividing wall between the flights of three locks at Gatun, with the approach walls which are in extension of the dividing wall, forms a mass of concrete 60 feet thick, about 81 feet high, and over 1⅛ miles long. The approach walls are of cellular construction. The dividing wall is built with the faces vertical and is solid for over half the height. Above the solid portion the center of the wall is filled with earth, except three superimposed tunnels. The lowest tunnel is used for drainage of the upper ones, the center tunnel for electric light and power cables, and the upper one as a passageway for employes to reach the various chambers containing machinery for operating the miter gates and the many valves. The exterior walls of the locks are of equal height with the central wall, and are from 45 feet to 50 feet thick at the floor-level; they diminish by steps on the back to a thickness of 8 feet at the top. The thickness of the floor is variable but is approximately 13 feet.

The emptying and filling of the locks is done through circular openings in the floor, each 3 feet 10⅞ inches in diameter and having an area of 12 square feet. There are five of them in each line across the lock, and the lines are spaced 32 feet to 36 feet apart. In one 1000-foot lock there are in all 105 openings with a total area of 1260 square feet. Each row of five openings communicates with a cross-tunnel under the floor. Eleven of these cross-tunnels in each lock lead to the outside wall and there open into a culvert 18 feet in diameter, without the inter-

position of valves. The remaining ten tunnels, alternating with the others, lead to the center wall where a cylindrical valve allows each tunnel to communicate with the culvert in the center wall, which is also 18 feet in diameter. The center-wall culvert receives the tunnels from both locks. It extends the full length of the three locks at Gatun, and at the upper end it opens into Gatun Lake, while the lower end discharges into the sea-level canal. There are control valves at each end and also in the line of the culvert at intermediate points corresponding to the locks. It is evident that, with a proper adjustment of the culvert valves, the water in any two lock chambers may be equalized by opening the cylindrical valves that allow the floor tunnels to communicate with the center culvert. This allows a very considerable saving of water in operation. With all culvert valves open, the center culvert may be used to discharge water from Gatun Lake into the sea. The side-wall culverts also extend the full length of the locks, and have control valves at the ends and at points corresponding to the ends of the locks, and at the subdivision points. They may be used in equalizing the water in any two locks that adjoin endwise, or in passing water into and out of the end locks. (See plan No. 6.)

LOCK-OPERATING MACHINERY.

All machinery connected with the locks is operated by electricity and has been specially designed for the canal work, based largely on previous experience with locks. There are 114 rising stem-gate valves, 120 cylindrical valves, and 92 machines for operating the individual leaves of the large miter-gates. The apparatus is equipped with remote control and position indicators, which show at the control switchboard the positions of the gates and valves during operation. Indicators also show the various water-levels. All regular operating machinery will be controlled by means of interlocking switches, with one central switchboard for each of the three groups of locks at Gatun, Pedro Miguel and Miraflores. There is also local control and hand operation where feasible. The whole installation is a good example of electric operation.

Realizing that a great deal of the machinery was of new type and that the operating conditions in a tropical climate would be unusually severe, the greatest care was exercised before finally deciding on the type and character of the apparatus. In most cases a sample piece was first made and actually tried out under

the severest working conditions, and changed if necessary before the order for the whole lot was given.

The cylindrical gate valves controlling the tunnels from the center-wall culvert consist essentially of a vertical cylinder placed in a chamber adjoining the culvert. The cylinder is seated at the bottom, and directly beneath it is a well to the floor culvert. A short lift gives a large waterway under the edges of the cylinder.

The great advantage of the cylindrical type is that it is very quick-opening, and that the water pressures are balanced and do not tend to prevent either opening or closing. On the canal a special form is used which does not involve carrying the full diameter of the cylinder above the water-surface.

The larger openings to the main culverts are controlled by rising stem gate valves of the Stoney pattern, similar to those used in the crest of the Gatun spillway dam. The gate is made of heavy structural steel, and the water-pressure is taken by a train of rollers at the back of the valve upon which the gate moves. Leakage is prevented by means of a metal water-seal extending around the face of the valve. This seal is fastened to the valve and slides on the wall of the opening and forms the only sliding friction of the whole valve.

Each mitering lock gate consists of two leaves hinged to the walls at opposite sides of the lock, and each leaf is 65 feet long; that is, longer than half the width of the lock, so that when the two leaves are closed, they form an angle pointing against the water-pressure. The 92 leaves weigh in the aggregate 60,000 tons, a weight in excess of that of two modern dreadnoughts. If all the gates were laid flat in a pile, it would be 644 feet high.

The joints at the hinges are made watertight by means of Babbitt metal. Embedded on the sill of the lock is a heavy block of wood, against which a similar block along the lower end of the gate fits. The water-tight joint, however, is made by means of a seal on the under side of the block on the gate in the form of a rubber flap ½-inch thick, which is forced against the seat by the water pressure itself. The weight of the gates is decreased by water-tight compartments near the bottom, which give flotation. A trunk extends from the deck to these compartments. Some of the upper water-tight chambers may be filled so as to control the buoyancy of the gates for different levels of water. When in motion the gates hang simply on their hinges, and there are no rollers on the floor of the dock.

Photo by Underwood and Underwood, New York.

FIG. 10.—Gatun Lower Lock, showing steel forms, overhead cableways, temporary concrete dam at lower end of lock, and partly completed sea-level canal in the distance.

CONSTRUCTING THE LOCKS.

In deciding on the site for the locks extensive and elaborate borings were made, indicating the exact character of the material. In every case a rock foundation was selected.

The Gatun Locks were constructed somewhat earlier than those at Pedro Miguel and Miraflores, and the method of building them also differed from that used for the others. The conditions were not so favorable for economical work. The three Gatun locks and the approach walls contain over 2,000,000 cubic yards of concrete. For purpose of comparison it may be stated that a large modern dry dock contains less than one-tenth this amount.

The broken stone was obtained from quarries at Porto Bello, which were opened particularly for the lock work. The material was quarried and crushed at Porto Bello, and was transported on barges in tow of commission tugs and carried through the old French canal, which happened to pass very close to the site selected for the locks. On account of the silting in of the old canal and the long haul, the cost of transportation was quite materially increased. The cost of the stone delivered at Gatun, including cost of plant and overhead charges, averaged $2.40 per cubic yard. The sand was dredged at Nombre de Dios and similarly transported on barges, at a total cost of about $2.10 per cubic yard. Cement was shipped from the United States to Colon, transferred by train and placed in storehouses at Gatun. The mixing of the concrete was done at a stationary mixing-plant. The stone, sand and cement were transferred by gravity, in proper proportions for each batch, to cars which dumped the materials into the mixers. After thorough mixing, the concrete was discharged into buckets on electric cars which ran on an automatically operated electric railroad. The cars were carried to tracks parallel to the locks and were stopped at the proper point. To transfer the concrete to the desired location in the lock, a number of aerial cableways were used, extending from one side to the other of the locks. The cable at one end was fastened to the top of a movable tower which contained hoisting apparatus, and at the other end the cable was fastened to a tower that was also movable but contained no machinery. The concrete was lifted from the cars, and by trolley operating on the cableway was carried over the point of deposit, lowered and dumped.

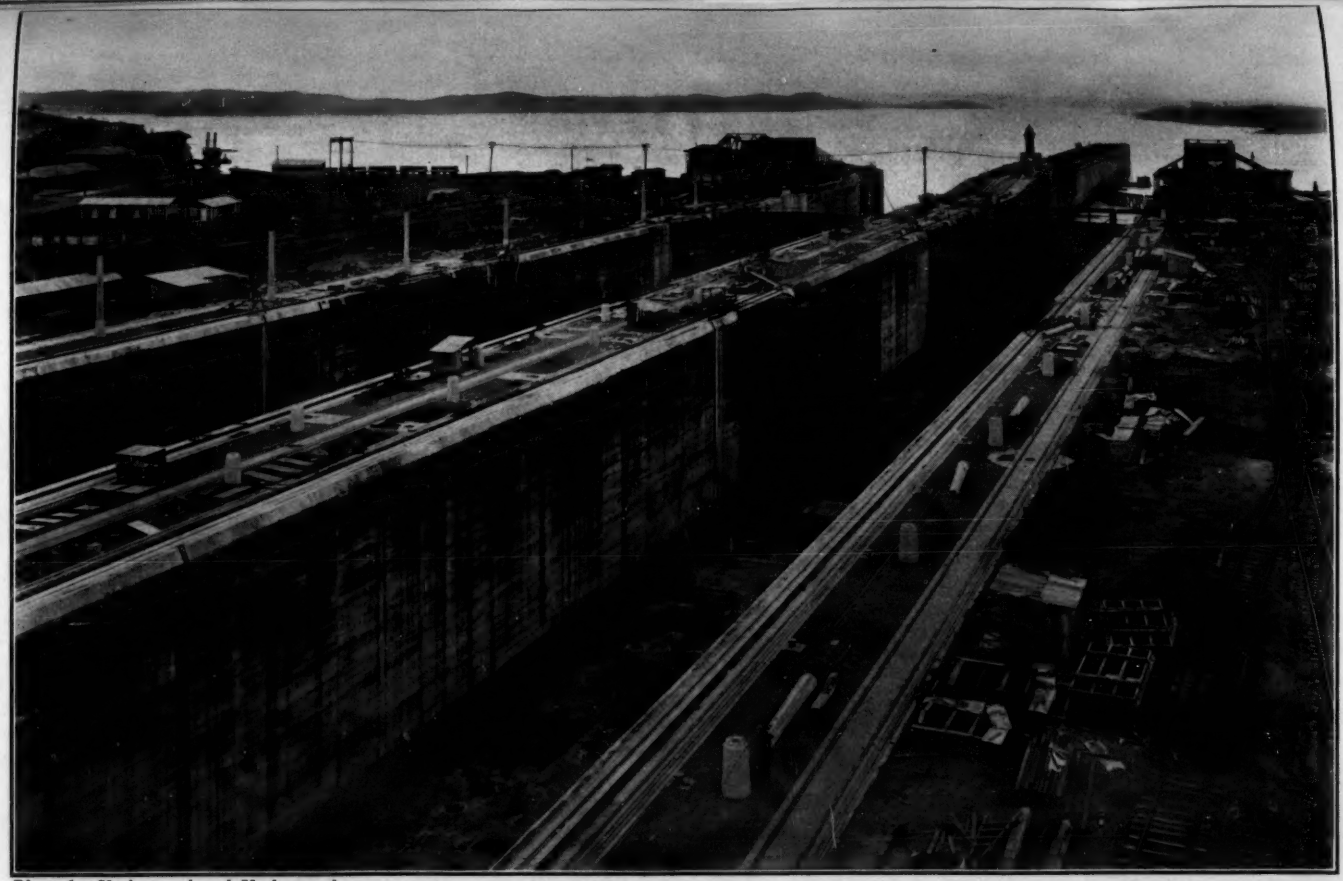


Photo by Underwood and Underwood.

FIG. 11.—Gatun Upper Locks, looking south from range light, showing Gatun Lake partly filled in the background. Other range light on approach wall.

The forms for the interior face of the side walls consisted of a heavy steel frame with steel face plates which were moved into position. The full height of the wall for the length of the form was then constructed, whereupon the form was moved to the next section. The cost of concrete on the Gatun locks was $6.64 per cubic yard in 1911 and $7.76 in 1912.

For the Miraflores locks broken stone was brought from a very large quarry opened high up on the side of Ancon Hill, where a satisfactory quality of stone was found. About 5,000 cubic yards of stone were turned out daily. Heavy blasts were set off above the berm, and steam-shovels then loaded the material into railroad dump cars, which were switched farther down the hill by locomotives to the top of a crusher, and were dumped directly into it. "Dobe" shots were fired off in the cars to split the stones which were too large. The crusher could take stones equal in size to that of an ordinary chair. The crushed material was screened, and that of proper size was carried by rubber belt to a sorting-screen and passed into the storage bins underneath for the various sizes. The material from the large crusher which was rejected by the screen passed into four small gyratory crushers, and from these on to the same belt for transfer to the sorting-screen. With this efficient and well arranged plant the cost of stone delivered at the site of the locks was about $0.82 per cubic yard.

Sand for the Miraflores Locks was obtained by dredging at Chamé and was transferred by barges to Balboa, where it was excavated by means of grab buckets and was placed in overhead storage bins for transfer by rail to the lock site. The total cost in storage at the locks was about $0.76 per cubic yard.

To handle the stone and sand in building the Miraflores Locks, an elevated trestle was built parallel to the locks and about 200 feet away. The cars dumped the stone on the side toward the locks, and the sand on the side away from them. On the bank between the locks and the storage pile a large cantilever crane operated on a track. The tower contained bins and hoppers and two large concrete-mixers. One cantilever arm overhung the storage piles, and a grab bucket kept the bins full. The other cantilever arm overhung the nearest lock wall and transferred the concrete from the mixers to the lock wall. The cement was taken directly from the cars to the tower without first going into

FIG. 12.—Miraflores upper locks, general view, looking north from lower locks. Steam-shovel excavation for lower locks in foreground. November 8, 1911.

Photos by Underwood and Underwood.

FIG. 13.—Concrete-handling cranes at Miraflores. The booms on the right carry the buckets which pick up the sand and stone from the storage piles and dump in bins over the mixers in center of crane. The booms on the left carry the concrete for dumping in the lock walls.

storage. In the lock chamber was another cantilever crane, which transported concrete to those parts of the lock beyond the reach of the mixing-crane. The entire plant is probably one of the most perfect ever devised for handling concrete. The cost of the concrete in place was $4.68 in 1911 and $4.77 in 1912, per cubic yard.

LOCKS AS THE LIMITING FEATURE.

The locks fix the maximum-size ship that may use the canal. They will pass the largest now built or building, but will not, for instance, pass the floating dry dock *Dewey*, which passed through the Suez Canal on the way to the Philippine Islands. The size of the locks was determined from the provisions of the Act of Congress approved June 28, 1902, which states: "Such canal shall be of sufficient capacity and depth as shall afford convenient passage for vessels of the largest tonnage and greatest draft now in use, and such as may be reasonably anticipated. . . . ."

In considering the limiting dimensions of the locks, and thus of the canal, it must be borne in mind that there has been a steady increase in the size of ships, upon which great emphasis has been laid. If curves are plotted to show the growth in length, width, depth and tonnage, especially if the maximum ship of each period is taken, and if these curves are extended to show future developments, the predictions are alarming. However, when the curves are produced beyond a certain point other factors not hitherto considered, and having no influence on the curves as plotted, are likely to enter. Shipbuilding has undergone an almost untrammelled development; building facilities, capital and cost have seemingly not retarded growth. Harbors have been deepened, channels have been widened, wharves, docks, locks and wet basins have been increased in size, to make way for the leviathans. The impetus toward larger vessels has undoubtedly been from economic reasons. Shipowners have found that with the larger and better equipped ships, having in view passenger traffic and advertising effects as well as freight, their ratio of income has increased and there has been nothing to curb their efforts. Communities and governments have, in their striving for all-important commercial growths, paid the bills for harbor development. As economic conditions have brought about the steep rise in the ship-growth curve, so economic conditions, but in another field, will

FIG. 14.—Toro Point Breakwater, two miles long, showing two-track trestle and rock fill.

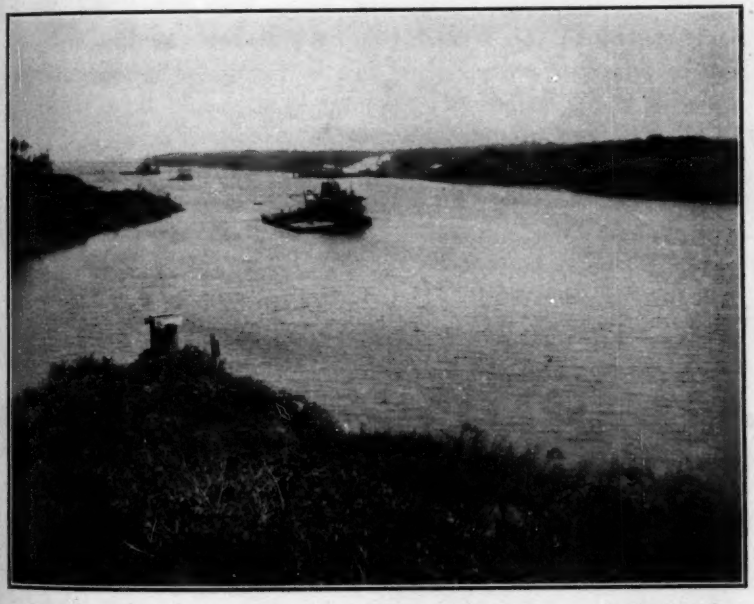


FIG. 15.—Mindi Excavation, view looking north from west bank, showing intersection of French and American canals. Atlantic entrance of canal in distance. March, 1913.

tend to flatten the curve. There must be a limit beyond which harbor development cannot economically go, and beyond which the sum of the cost of shipping and building and the cost of construction and maintenance of port works will increase rather than decrease. It will be difficult to determine when this point is reached, especially because the same interests do not provide capital for both enterprises. There are already occasional indications that this factor is entering. The difficulty in providing for the largest ships in New York harbor, while from one standpoint a physical one, is in the last analysis economic.

There is now no commercial necessity why the Panama Canal should accommodate the largest ships; the largest ships may be regarded as ocean ferries with fixed ports. The total estimated traffic capacity of 80,000,000 tons can be handled in ships under 600 feet long, which comprise 95 per cent of the world's tonnage, but within the next generation the canal may become one of the elements which exercise a retardant influence on the maximum size of ships, depending on developments in the commerce of the world.

More important is the effect of the canal on the size of naval vessels. Battleships of the United States have increased in beam from 76 feet in 1900 (date of authorization) to 80 feet in 1905, 88 feet in 1908, and about 98 feet in 1912; and if this ratio of increase is maintained, the limiting beam would be reached in ships authorized in about 1915.

It is worthy of note that the locks of the enlarged Kaiser Wilhelm Canal from the Baltic to the North Sea are 1082 feet long and 147 feet wide, but the lift is very much less than at Panama.

THE SEA-LEVEL SECTIONS AND THE TERMINALS.

Limon Bay, through which the Atlantic sea-level section passes, faces directly north and is open to the northerly storms and seas, which are quite severe at certain times. Protection was necessary in order, first, that ships might enter the canal in quiet water; second, to provide a quiet anchorage; third, to make traffic in small boats feasible and safe between the shore and ships at anchor; fourth, to prevent the movement of silts and sands by the seas and the attendant dredging expenditure. (See plan No. 2.)

To give this protection, Toro Point Breakwater has been constructed, extending from Toro Point in a northeasterly direction for a distance of about 2 miles. The outer end does not quite cover the entrance to the canal. The breakwater protects the greater part of Limon Bay from the northerly storms, but the easterly portion is still exposed, especially to seas and storms from a northeasterly direction. The construction of a breakwater to close this part of the bay was postponed to await the results of actual experience with the one at Toro Point. It is probable that this breakwater will ultimately be built, as the present protection is not sufficient, especially for boating, and as the effects of wave action cause silting of the channel.

The breakwater is constructed from a trestle supported on creosoted piles 85 feet long and having two tracks. The piles are driven by a railroad pile-driver with very heavy hammer, which can reach all of the piles from either track. Stone from a Toro Point quarry is carried in cars on the trestle and dumped overboard, and forms the core of the breakwater. Porto Bello stone, which is harder and much more durable, is transported a distance of about 28 miles on barges and is carefully deposited on the exterior by means of derricks. The breakwater is 20 feet in width on top, and is built in water from 35 to 50 feet in depth. The height of the top above the surface of the water is about 16 feet. The total quantity of material placed to December 31, 1912, when the breakwater was nearly completed, was 954,500 cubic yards, at an average cost of $2.20 per cubic yard. In addition, 620,000 cubic yards of rock dredged from the canal was deposited in the vicinity of the breakwater. During the fiscal year 1912 the Toro Point rock cost $1.38 per cubic yard, and the Porto Bello rock $4.31.

A large anchorage basin is provided between Cristobal and the canal channel. The wharfage space at Cristobal is being increased. New piers are built on steel cylinders which were excavated inside by hand and gradually forced down. The cylinders upon reaching the proper depth were filled with concrete, and a superstructure was built upon them of reinforced concrete.

To complete the Atlantic sea-level section, from the outer end to its terminus at the Gatun Locks, required the excavation of over 32,000,000 cubic yards by dredging, costing over $7,600,000, or about 24 cents per cubic yard; and over 2,000,000 cubic

yards by steam-shovel, costing over $1,450,000.00, or about 67 cents per cubic yard.

The Pacific sea-level section from the Miraflores Locks to Panama Bay cuts the winding channel of the Rio Grande River and then continues through the bay. The land is all very low. This channel up to December 31, 1912, when the work was well in hand, had required the excavation of over 34,500,000 cubic yards by dredging, at a total cost of over $8,500,000.00, or about 25 cents per cubic yard; over 2,500,000 cubic yards by steam-shovel, at a cost of over $2,000,000.00, or about 80 cents per cubic yard, and in addition over 1,500,000 cubic yards by hydraulic excavation, at a total cost of over $1,100,000.00, or about 72 cents per cubic yard. The hydraulic excavation consisted in dislodging the earth by means of powerful streams of water and carrying the material, water-borne, to suction pumps which discharged it on the neighboring swamps. A great deal of submarine rock was excavated, partly through the use of a Lobnitz rock-breaker, which shattered the rock by dropping a heavy cylindrical shaft, and partly through the usual process of submarine drilling and blasting. (See plan No. 3.)

It was originally intended to carry the canal into deep water on the easterly side of the group of islands Naos, Culebra and Flamenco, which lie about 3 miles off shore. A study of the conditions developed the fact that the strong littoral currents carried silt in a westerly direction, and as the shores of the bay are lined with a very fine mud, this action would cause the dredged channel to fill continually. For these reasons it was decided to carry the channel to deep water west of the group of islands, and to build a breakwater or dike from the shore at Balboa to Naos Island, about parallel to the canal. The object of the breakwater was not to give protection from seas or storms, for these are unknown on the Pacific side of the Isthmus, but to prevent the movement of silt into the canal, to shut off the swift tidal currents which would carry vessels at right angles to their course, and incidentally, to provide a roadway from the mainland to the fortifications on the islands. An ample amount of material was available from the excavations in the Culebra Cut, which necessarily required disposal somewhere. The breakwater, or dyke, was built by means of a trestle of creosoted timber piles, from which railroad cars dumped their

material into the water. The trestle was over three miles in length, and as stated in the annual reports of the commission, was driven for a greater part of its length in blue mud, varying from a few feet to 102 feet in depth. The mud particles are exceedingly fine, and the substance feels greasy and slippery, and has a very low coefficient of friction. The mud was not able to carry the weight of the stone dumped from the trestle, and the stone and trestle were continually sinking and shifting laterally. At one locality, the total vertical displacement aggregated 125 feet in a single year. In some cases the lateral displacement of the trestle was as much as 300 feet. The pressure of the stone was greatest when a 20-foot tide was out, and the displacements usually occurred at low water. The rock in settling caused parallel ridges of mud to rise about 80 feet from the center of the track. At one point a record was kept of the amount of material required to bring the stone fill up to a full height of 29 feet above the original bottom, and it was actually ten times as much as computations taking no account of settlement indicated as necessary. Such occurrences might have been very serious, but in this case unlimited material was available from the cut, and the total cost of the work was not excessive. In fact, the total cost of the dike up to December 31, 1912, was $300,000.00 for 1,121,000 cubic yards, or at the rate of about 27 cents per cubic yard, or about $13.00 per lineal foot. Costs are exclusive of the amount that would have been spent to dispose of the materials on the ordinary dumps.

The principal ship-repair plant will be on the Pacific end of the canal. There will be a large dry dock, equal in capacity to that of the locks, with an entrance of at least 110 feet clear width and a clear length of 1,000 feet. A smaller dry dock will also be built. The ship-repair yard is designed to afford repair facilities for all of the Panama Canal plant, and for visiting ships. It will comprise foundries, machine shops, equipment for shipfitting, woodworking, paint shops, storehouses, and all the other necessary outfit for the work that it will be called upon to do. Its general character will be similar to that of a large navy yard. The plant will be a valuable asset to the United States Navy, especially in time of war. There is at present a small dock and repair plant at the Atlantic end.

Unloading piers are being provided at Balboa in addition to the present facilities, similarly as at Cristobal. It is probable that there will be an anchorage basin near the dock yard, though rock bottom is a deterrent influence.

Two of the largest floating cranes in the world will form a part of the equipment, and these will be of the revolving type. They will have a lifting capacity of 250 tons at 22 feet reach, or 150 tons at 62 feet reach, and 100 tons at 82 feet, with a hook 100 feet above the surface of the water. Their stability will be retained under any and all conditions of loading, without shifting ballast or counterweight, except that the revolving structure will be counterweighted. The two cranes acting together will be able to lift any one of the enormous mitering lock gates.

The coaling plant at the Pacific end will have a total storage capacity of 135,000 tons, of which 75,000 tons will be subaqueous. Arrangements are made for separate storage of coal belonging to different owners. The capacity of the plant for unloading from colliers will be 500 tons per hour, and the total issuing capacity will be 1000 tons per hour. It is proposed to furnish coal by sale to passing vessels. The Cristobal coaling plant will be larger, and will have a total storage capacity of about 240,000 tons, of which 125,000 tons will be subaqueous. The capacity for unloading from colliers will be 1000 tons per hour, and the total issuing capacity will be 2000 tons per hour. The government will own and operate a large number of coal and oil lighters at each end of the canal. Oil storage and an oil pipe-line across the Isthmus will also be provided.

CONTROL OF WATER DURING CONSTRUCTION OF THE CANAL.

One of the serious problems that arose in connection with the actual construction of various parts of the canal has not been touched on in describing items such as the locks, dams, and Culebra Cut, because it can be better treated as an individual subject. We realize that the canal is built in the valleys of the Chagres and Rio Grande Rivers, and that the route selected is the very lowest one that could be found. Knowing the character of tropical rainstorms and river floods, it needs but a moment's thought to make clear the seriousness of the problem of keeping the storm waters and the floods away from the construc-

tion work. Improperly or insufficiently controlled, these waters would have the power to destroy a great deal of what had been laboriously done.

The Culebra Cut forming the low point for many square miles of territory, and coinciding for a considerable distance with the Obispo River valley, would naturally collect vast quantities of water were steps not taken to prevent it. The course of the Obispo River was artificially changed, beginning at the point where it approached the cut. The total length of the new river channel as originally built was 5¼ miles, from a point on the east side of the Culebra Cut, near the foot of Gold Hill, to a point clear of the cut, and finally discharging into the Chagres River. On account of slides encountered during construction work, the Obispo diversion gave way, and the flow of the river entered the cut for 3 days, causing inconvenience and damage. A new diversion channel was constructed with great speed. That the Obispo diversion was no small problem may be noted from the fact that in six years a total of 1,200,000 cubic yards of excavation was necessary, of which nearly 40 per cent was in rock, and the total cost was over $1,000,000.00. The diversion was able to carry 6000 cubic feet of water per second. The Camacho diversion on the opposite side of the cut was similarly built.

These two diversions take waters which flow toward the Atlantic. The Rio Grande River formerly flowed through part of the area to be excavated on the Pacific side of the Continental Divide. It was similarly diverted, and a dyke was constructed across the south end of the canal to prevent access of the river water. Keeping water out of the cut also kept out the silt which would inevitably have come down with the freshets.

The elevation of the bottom of the cut was 40 feet, which was lower than the Chagres River, and a dam was built across the cut with its crest at elevation 73 to prevent the river from flowing into it.

The natural streams being thus prevented from entering the work, it only remained to get rid of the water which originated along 8¼ miles of cut. This was done by means of centrifugal pumps at low points in the cut, which discharged the water over the dams. Excavation at a new level was always preceded by the cutting of a pioneer trench down the middle of the canal, in

which all the water was collected and carried to the pumping stations. The summit during construction was at Culebra. Drainage to the south was carried to Pedro Miguel until August, 1911, when the flow was taken through the center-wall culvert of the Pedro Miguel Lock. The drainage to the north was disposed of by pumping.

The Chagres had no opportunity to interfere with the Culebra Cut, but had ample opportunity by virtue of its location, to threaten the work on the Gatun Dam. This problem was handled with ingenuity by the engineers. The portions of the dam not accessible to the river were constructed first. The spillway was built with its foundations on rock and with the river kept out by cofferdams and otherwise. In the meantime the Chagres River flowed through the west diversion built by the French. When the spillway, in 1911, had been constructed to elevation 10 feet above sea-level, and the earth dam well above this elevation, the channels of the Chagres were closed by carrying the dam across, and the water then flowed over the concrete work of the spillway during the rainy season. This depth kept the Panama Railroad, still on the old line in the Chagres valley, free of water. During the following season the railroad was transferred to the relocated or high line above the final level of Gatun Lake. The earth dam was continually kept at an elevation well above that of the concrete work of the spillway, and the next step during the dry season consisted of constructing 4 very large culverts in a part of the spillway temporarily protected from the flow of the water and controlled by gates. There were provisions for placing stop planks for closing the openings at some future time. When these culverts were completed, the dry-weather flow of the river was carried through them, and the remaining concrete work of the spillway progressed so long as the dry season lasted, and so long as the culverts were able to carry the flow. During the rainy season the flow was again over the concrete work of the spillway at elevation 50. Proceeding thus, the spillway was completed, and the final step, when the spillway is entirely done, consists in placing the stop planks before the entrance to the 4 culverts and filling them with concrete.

The Gatun Locks extend to a depth of about 55 feet below mean sea-level, and the water was kept off the site by means of a temporary dam to the north of the locks. This was built so

that the excavation for the flare-walls might be done by dredges, as the material was too soft to hold steam-shovels. Inasmuch as the dredges could not dig the full depth of 70 feet, a small lake was formed over the area of the flare-walls, and its elevation was lowered until the dredge could reach the bottom. This lake was kept from flowing into the partially completed locks by means of a temporary concrete dam, built between the center and side walls near the lower end of the Gatun Locks.

AIDS TO NAVIGATION.

The Atlantic entrance will be marked by a light of the fourth magnitude placed on the end of the Toro Point Breakwater, where there will also be a compressed-air fog whistle and a submarine bell. The tangents in the canal will be defined by range lights. Vessels going in opposite directions will use different ranges giving courses 250 feet apart. There will also be side lights, spaced about 1 mile apart on each side of the channel. In the Culebra Cut the range lights are omitted, due to the tangents being so short and the banks too steep for placing them. There will be, instead, 35 concrete beacons at tangent points and and at intermediate locations. By a system of screening, only those lights will be visible to the navigator which are necessary to define the channel where the ship may be.

The sides of the canal will be further marked by acetylene, flashing gas buoys of 450 candlepower, and intermediate spar buoys.

The range lights involved much clearing of forest growth, since the trochas are in general of the full width of the canal at the start, narrowing down to 480 feet at the rear light.

All lights, beacons and buoys will be white, and will be distinguished from one another by characteristic flashes. Gas and electricity will be used for illuminant, preferably electricity where feasible. Inaccessible lights will be operated by means of compressed acetylene dissolved in acetone.

The locks will be illuminated by means of 400-watt tungsten lamps on concrete posts, with concrete reflectors. The lamp will be 30 feet above the coping and will be screened by concrete skirts, so as to cut off the direct light rays longitudinally of the locks, thus keeping the glare out of the navigator's eyes.

SANITATION.

To regard the sanitation work as a mere contributory element to a successful culmination of the canal construction work does not, perhaps, place it upon the high plane that it deserves. Rather should we regard it as one manifestation of the great progressive movement that is now pervading civilization and that regards the prevention of disease as of more importance than its cure, and in its execution requires the coöperation of the physician, the bacteriologist, the engineer, and the administrator. The Panama Canal is undoubtedly the most marked single example the world has seen of the intelligent and thorough application of the principles of sanitation. In many other parts of the world, and for years, such principles have been applied in preventing contamination of water supplies, in the purification of sewage, in the control of epidemics and in other important sanitary measures; but none have had the opportunity to display in so marked and convincing a way the great benefits to be derived, especially with the example of the French experience for a background. In no case has more been done to educate the world in general in the need and effectiveness of the application in a practical way, under control of experts, of the scientific principles of sanitary science. We can with truth, therefore, say that the sanitary work on the Isthmus has extended beyond the confines of the Canal Zone and of canal construction, and its good effects on the whole human race rival those of the canal accomplishment itself.

The very title of the "Department of Sanitation" is indicative of the new era; in the old days there would have been a department of hospitals. The new era gives a department of health and its preservation, of sickness and its prevention and cure, and the old merely gave a department for the care of the sick.

Of some of the numerous activities of the Department of Sanitation, such as the Colon and Ancon hospitals, the system of vital statistics, the control and inspection of foods, the discovery and isolation of infectious diseases, and the handling of accident or emergency cases, we may only note in passing that all are well administered and rank with the best of their class in the world. The phases of the work which interest us more are the control of yellow fever and malaria.

The Americans in Cuba proved that yellow fever was communicated only through the *stegomyia* mosquito. It had been proven

that malaria was communicated through another type of mosquito known as the *anopheles*. Knowing these facts, the fight against yellow fever resolved itself into several elements: 1st, prevent the introduction of yellow fever into the Isthmus by strict quarantine; 2d, isolate all yellow fever cases within doubly screened rooms, to prevent the stegomyia from gaining access to yellow fever germs and thus gaining the power to communicate it to others; 3d, screen all living spaces, so as to prevent access of the dangerous mosquitoes to the well; 4th, study the habits of the mosquitoes and exterminate them so far as possible, especially those having been in the presence of yellow fever. In accordance with these principles, all hospitals, hotels, dwellings and offices were most carefully screened; the yellow fever rooms in the hospitals were separated by screens from the rest of the hospital. Most careful and comprehensive inspections and studies led to the finding of the breeding-places of the dangerous mosquitoes and to the removal of the pools of water. In the cities all open cisterns and accidental lodgments for pools of water were removed. In the open country swamps were drained or filled; extensive systems of ditches were established and maintained; pools that could not be removed were coated with a disinfectant that prevented breeding; underground drains were placed to run off the water before it could ooze to the surface and form pools. Larvicide was liberally distributed on stagnant water that could not be drained; it was manufactured in concentrated form, was carried to the brooks in the mountains, and was arranged to drip automatically on the streams, so that if pools should form, the film of destructive liquid would already be there. Underbrush and grass were cut near all habitations, so that the sun might dry up possible pools and the mosquitoes be deprived of shade, and perish. Fish were tried for their destructive effect on mosquito larvæ. The cities were cleaned, sewered, paved, and provided with water. In fine, no possible precaution that intelligence and diligence could devise was overlooked.

The result was the banishment of the hitherto prevalent yellow fever, a marked diminution in the amount of malaria, and generally healthful conditions accompanied by a low death-rate.

Sanitation work is expensive; the cost, to June 30, 1912, has been $15,000,000.00.

THE ELEMENTS OF SUCCESS.

A consideration of the elements to which the undertaking owes its accomplishment is most important and interesting, in order to correctly comprehend how success was achieved. It must first be admitted that fortune favored us. We did not apply our determination to build the canal to actual construction work until after the world had fully developed the mosquito theory, and Cuba had given us an opportunity to apply it to practical sanitation.

Two generations of railroad building, river and harbor improvement, water-works, and other large construction, together with the coincident growth of the great technical schools, had developed a body of engineers and constructors with the technique and capacity for conceiving and executing large works, and a strongly formed spirit of loyalty and devotion that allowed them to be welded into the nucleus of a great organization. Everywhere on the work are evidences of the standard practice developed by engineers on other undertakings and adapted to local conditions. Without these years of preliminary engineering training, the Panama Canal as built would have been impossible.

The management of the enterprise was first placed in the hands of engineers and others who had been eminently successful in great works conducted by private capital. They were undoubtedly able men and contributed enormously to the primary work, and are deserving of great credit. They had not had experience in conducting work under the many restrictions imposed by the government, and in dealing with superiors who were representatives, not of capital and business, but of the people of the United States. The large body of engineers in the employ of the United States were at first passed over when the greatest and most responsible engineering positions ever at the disposal of the government were to be filled. They had devoted their lives to the service and were now ignored. After but a short interval a change came, and the management was turned over to government engineers. The selections were made from the oldest, and, as a body, the most experienced, organization of engineers in the government service, the Corps of Engineers of the United States Army, and to a lesser extent, from the Corps of Civil Engineers of the United States Navy. The results of the work are a sufficient tribute to the wisdom of the selection.

The evidence is clear that a strong national sentiment pervades the force, which lends inspiration to self-sacrificing coöperation, to hard work, and to contentment under discomforts—a sentiment intensified through isolation in a foreign land. It finds expression not only in the canal employe, but in every American who admires and looks up to his fellow citizen who has worked on the canal. This element of success is fundamental, and rarely has an enterprise given so good an opportunity for its display. It might easily have been smothered by ill-advised administration, but the organization is blessed with a leader who says that "we" are building the canal, and whose inspiration leads all to take the same view. It is remarkable to note the extent to which a feeling of loyalty to the work exists, rather than to the individual or to any division. Even a company agent resident on the Isthmus, in referring to the Pacific Division, states that "*We* put in 4500 cubic yards of concrete on the locks yesterday." This general feeling of loyalty in no way excludes a healthful rivalry for each crew or division to excel. The individual who would ordinarily be disgruntled or dissatisfied soon leaves the Isthmus, or he finds those feelings pushed into the background or smothered by the all-pervading spirit of loyalty to the work. The whole is an interesting psychological problem, which only a visit to the Isthmus can disclose in all its force.

In the valuation by the Americans of the French canal company's property, one notable item, though an intangible one, is missing—the value to us of the French experience, the lessons learned by them through years of bitter experience. Had we begun the canal as pioneers, it is of course impossible now to state what costly mistake we might have made or what untoward conditions we might have overlooked; there can be no doubt that the knowledge of what the French had done aided us in making up our minds what to do and what not to do. One of the greatest errors of the French, and one that contributed most largely to their failure, was that they did not realize until too late the magnitude of the enterprise.

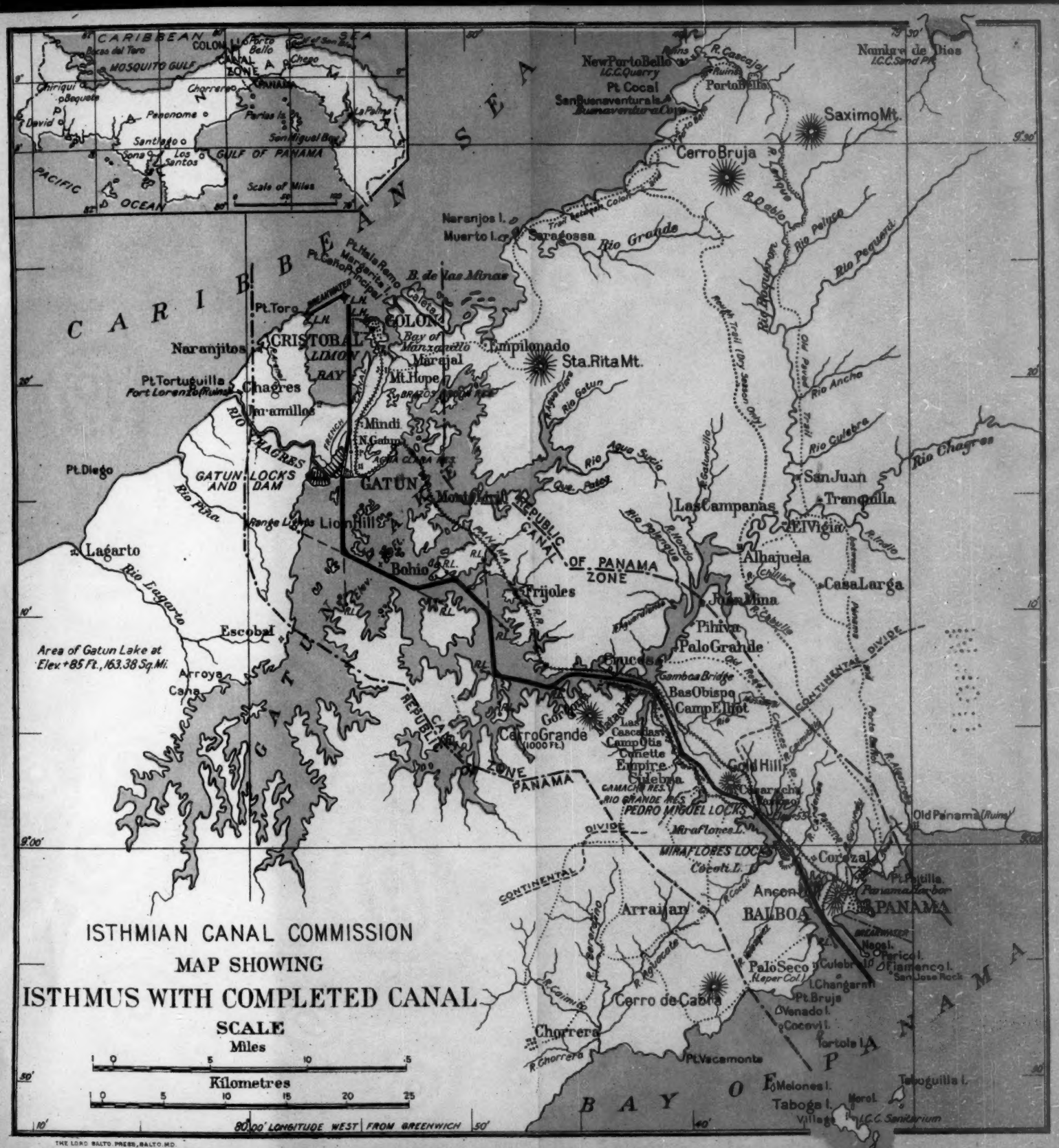
In a material way the most valuable contributions to the elements of success were the well developed state of the art of making concrete, the perfected steam-shovel, compressed-air tools and numerous other mechanical devices.

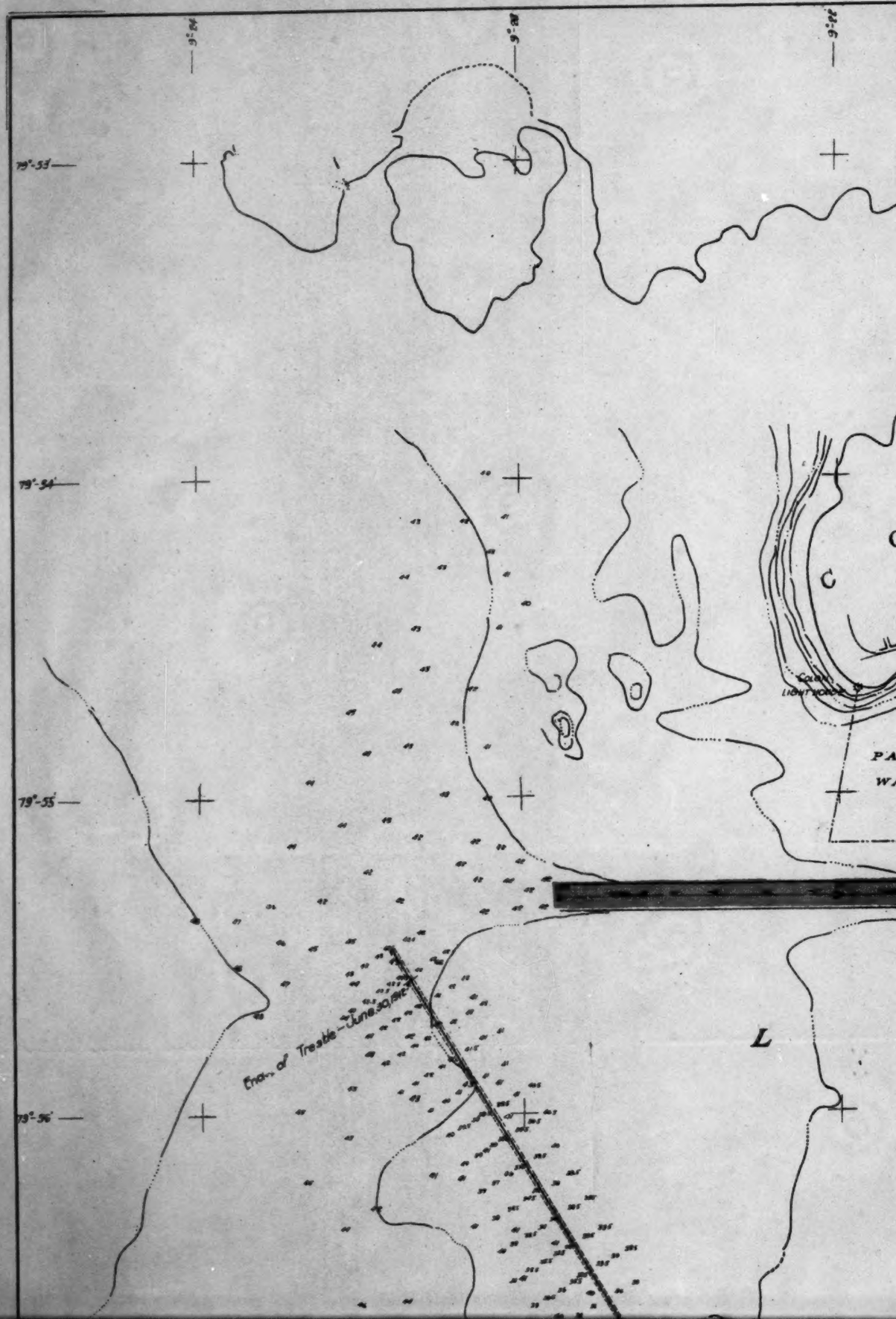
IN CONCLUSION.

There is so much of interest connected with the subject of the Panama Canal that the most difficult problem in writing a limited article about it is to decide what to omit. The organization of the forces, the system of accounting and cost-keeping, the method of civil government, the Panama Railroad, the administration of the subsistence and storekeeping divisions, the importance of the canal to the navy, and many other subjects, offer a wealth of material—sufficient for separate essays—and are well worthy of study. All branches pertaining to the execution of the work have been studied out to a point of maximum possible efficiency, and that this has been possible is largely due to the absence of hide-bound precedents and to the fact that control was left to the man on the ground.

The canal will soon be completed and begin its history as an actuality. Study and statistics throw much light upon what its commercial history will be. No one may venture to predict what momentuous influence it may have in war or in preventing war. Whatever may be the detailed events in which the canal may take a part, there can be no doubt that it is one more step in the westward trend of civilization. The prophecy of sixty years ago by that farseeing statesman, William H. Seward, made in a speech in the Senate, is still in remarkable process of fulfillment:

> Even the discovery of this continent and its islands, and the organization of society and government upon them, grand and important as these events have been, were not conditional, preliminary and ancillary to the more sublime result now in the act of consummation, the reunion of the two civilizations, which, parting on the plains of Asia 4000 years ago, and travelling ever after in opposite directions around the world, now meet again on the coasts and islands of the Pacific Ocean. Certainly no mere human event of equal dignity and importance has ever occurred upon the earth. It will be followed by the equalization of the condition of society and the restoration of the unity of the human family. Who does not see that henceforth, every year, European commerce, European politics, European thought and activity, although actually gaining greater force, and European connections, although actually becoming more intimate, will ultimately sink in importance; while the Pacific Ocean, its shores, its islands, and the vast regions beyond, will become the chief theater of events in the world's great hereafter?


CARIBBEAN SEA
COLON
Porto Bello
MOSQUITO GULF
CANAL ZONE
PANAMA
Chiriqui
Bocqueta
David
Chorrera
Penonome
Perlas Is.
La Palma
Santiago
San Miguel Bay
Los Santos
GULF OF PANAMA
PACIFIC OCEAN
Scale of Miles
NEW PORTO BELLO
I.C.C. Quarry
Pt. Cocal
San Buenaventura Is.
Buenaventura Cays
Portobello
Saximo Mt.
Nombre de Dios
I.C.C. Sand Pit
Cerro Bruja
Naranjos I.
Muerto I.
Saragossa
Rio Grande
Rio Pequeni
Pt. Hale
Pt. Remo
Margarita I.
Pt. Cañon Principal
B. de las Minas
Caleta
Pt. Toro
COLON
CRISTOBAL
Bay of Manzanillo
Naranjitos
LIMON BAY
Tumpilonado
Sta. Rita Mt.
Marajal
Mt. Hope
Pt. Tortuguilla
Fort Lorenzo (Ruins)
Chagres
Juramillos
Mindi
N. Gatun
RIO CHAGRES
Pt. Diego
GATUN LOCKS AND DAM
GATUN
Monte Mario
Lion Hill
Rio Piña
Lagarto
Rio Lagarto
Bohio
REPUBLIC OF PANAMA
CANAL ZONE
Frijoles
Las Campanas
El Vigia
San Juan
Tranquilla
Rio Chagres
Alhajuela
Casa Larga
Juan Mina
Pihiva
Palo Grande
Escobal
Area of Gatun Lake at Elev +85 Ft., 163.38 Sq. Mi.
Arroyo
Cano
Gamboa Bridge
Bas Obispo
Camp Elliot
CONTINENTAL DIVIDE
Matachin
Las Cascadas
Camp Otis
Corozal
Pt. Paitilla
Panama Harbor
PANAMA
Ancon
BALBOA
Arraijan
Naos I.
Perico I.
Flamenco I.
San Jose Rock
Palo Seco
Leper Col.
Culebra
Gold Hill
Cascadas
Camacho
Empire
Culebra
CAMACHO RES.
RIO GRANDE RES.
PEDRO MIGUEL LOCKS
Miraflores L.
MIRAFLORES LOCKS
Cocoli L.
Old Panama (Ruins)
I. Changarra
Pt. Bruja
Venado I.
Cocoli I.
Cerro de Cabra
Chorrera
Tortola I.
Pt. Vacamonte
Melones I.
Taboga I.
Taboguilla I.
Morol
Villages
I.C.C. Sanitarium
BAY OF PANAMA
ISTHMIAN CANAL COMMISSION
MAP SHOWING
ISTHMUS WITH COMPLETED CANAL
SCALE
Miles
Kilometres
80° 00' LONGITUDE WEST FROM GREENWICH
THE LORD BALTO. PRESS, BALTO. MD.


79°-53'
79°-54'
79°-55'
79°-56'
End of Trestle - June 30, 1941
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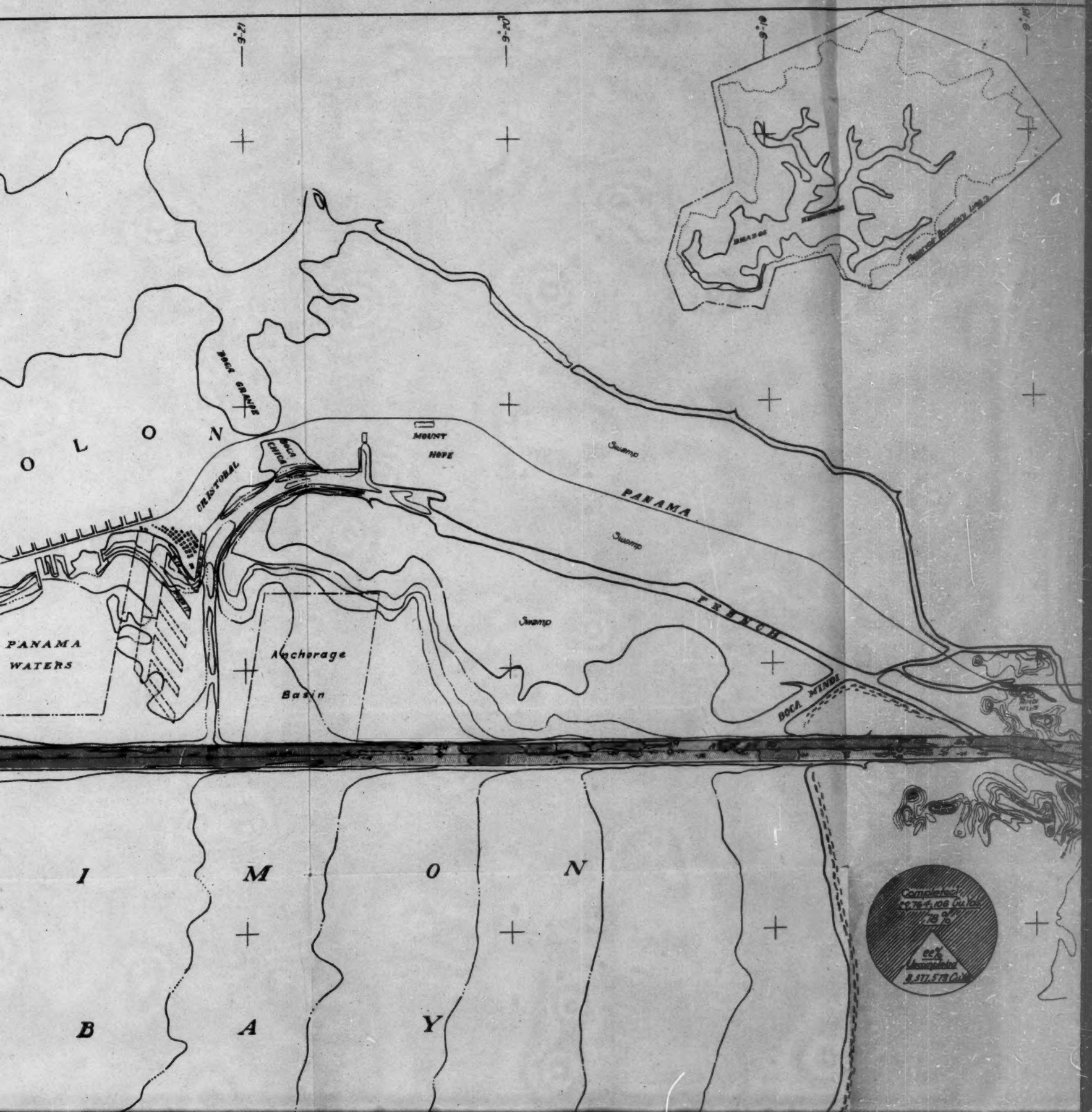

O L O N
CRISTOBAL
MOUNT HOPE
Swamp
PANAMA
Swamp
FRENCH
Swamp
PANAMA WATERS
Anchorage Basin
BOCA MIND
I M O N
B A Y
Completed
78 %
Uncompleted
22 %

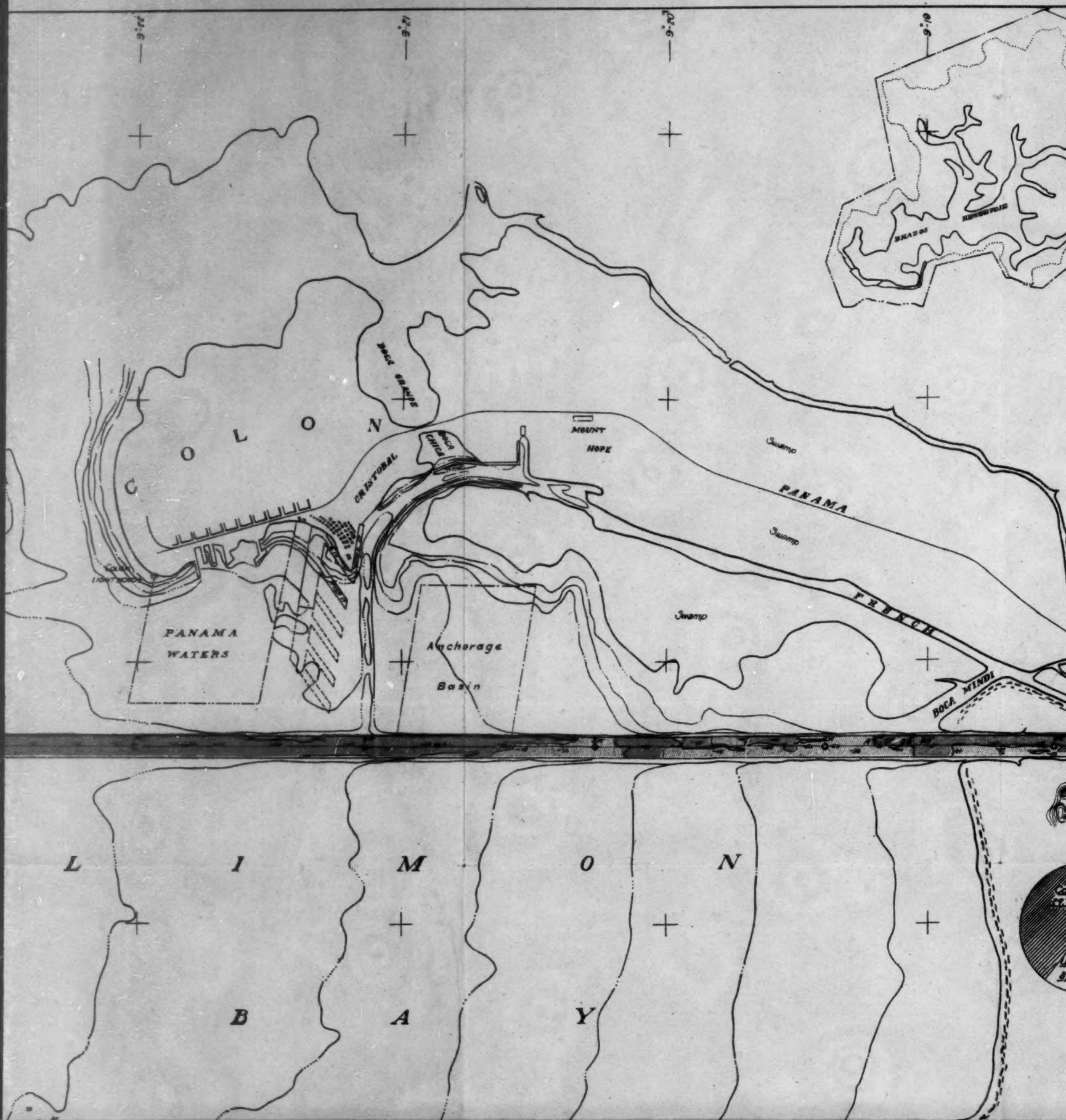
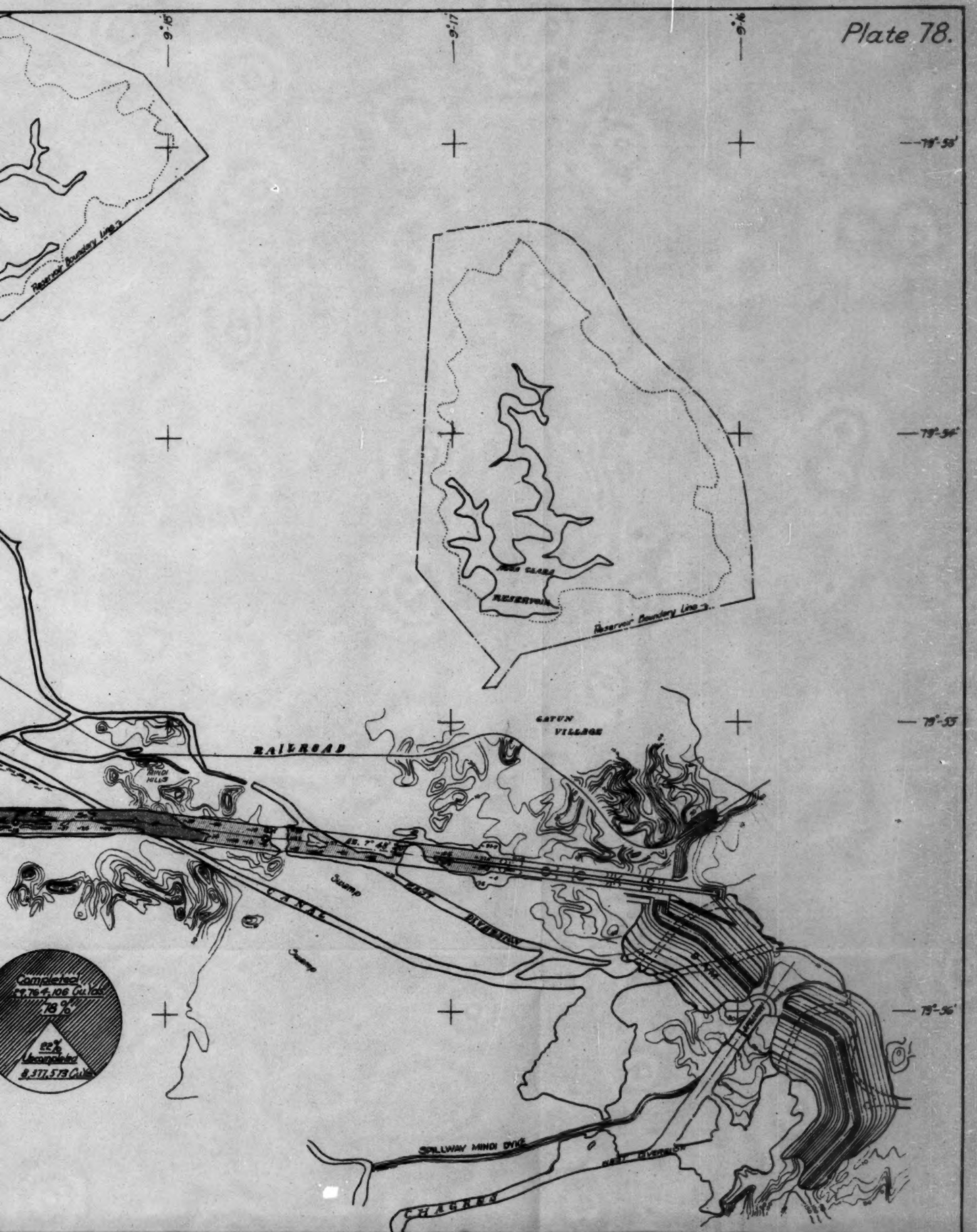
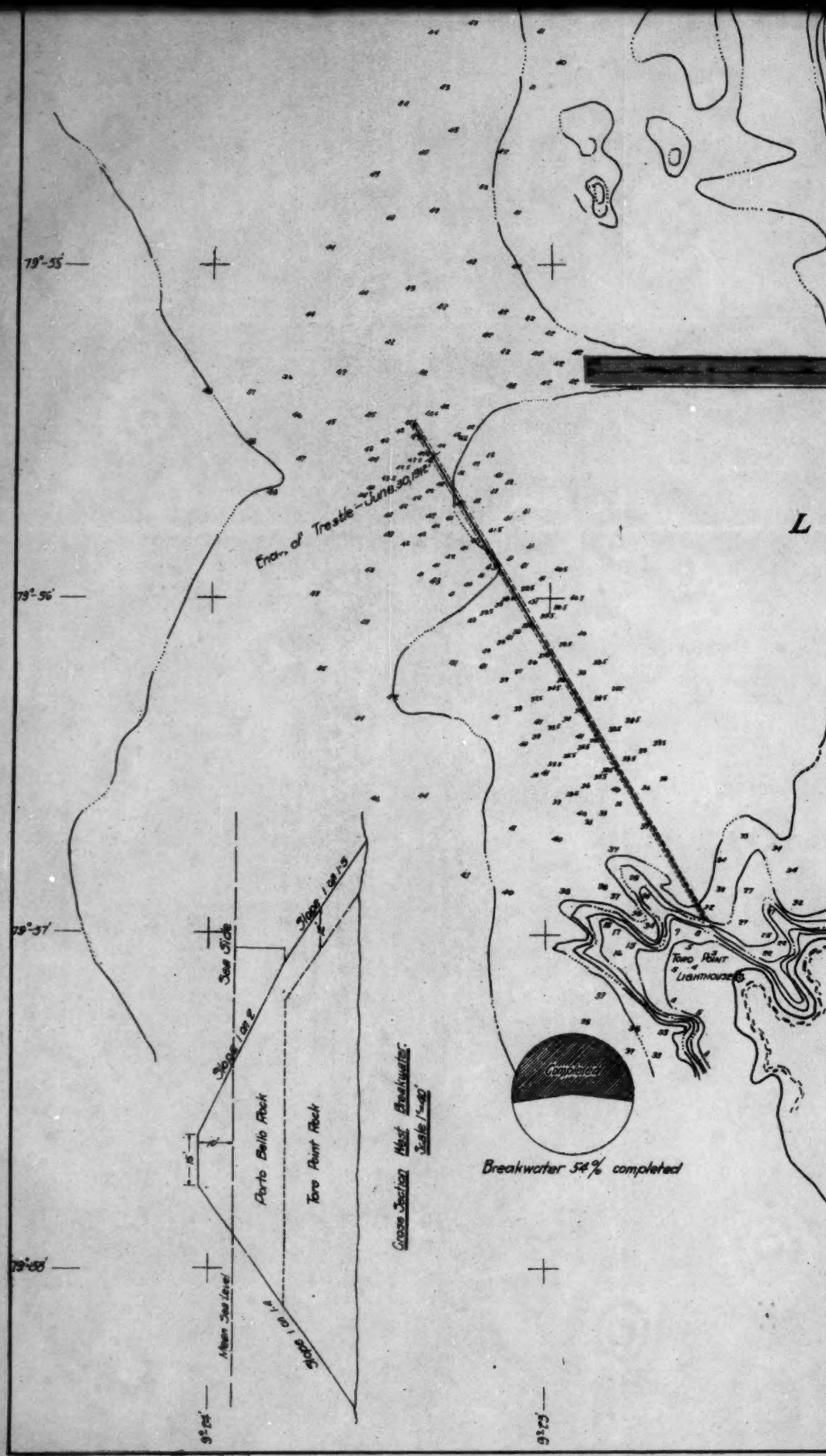
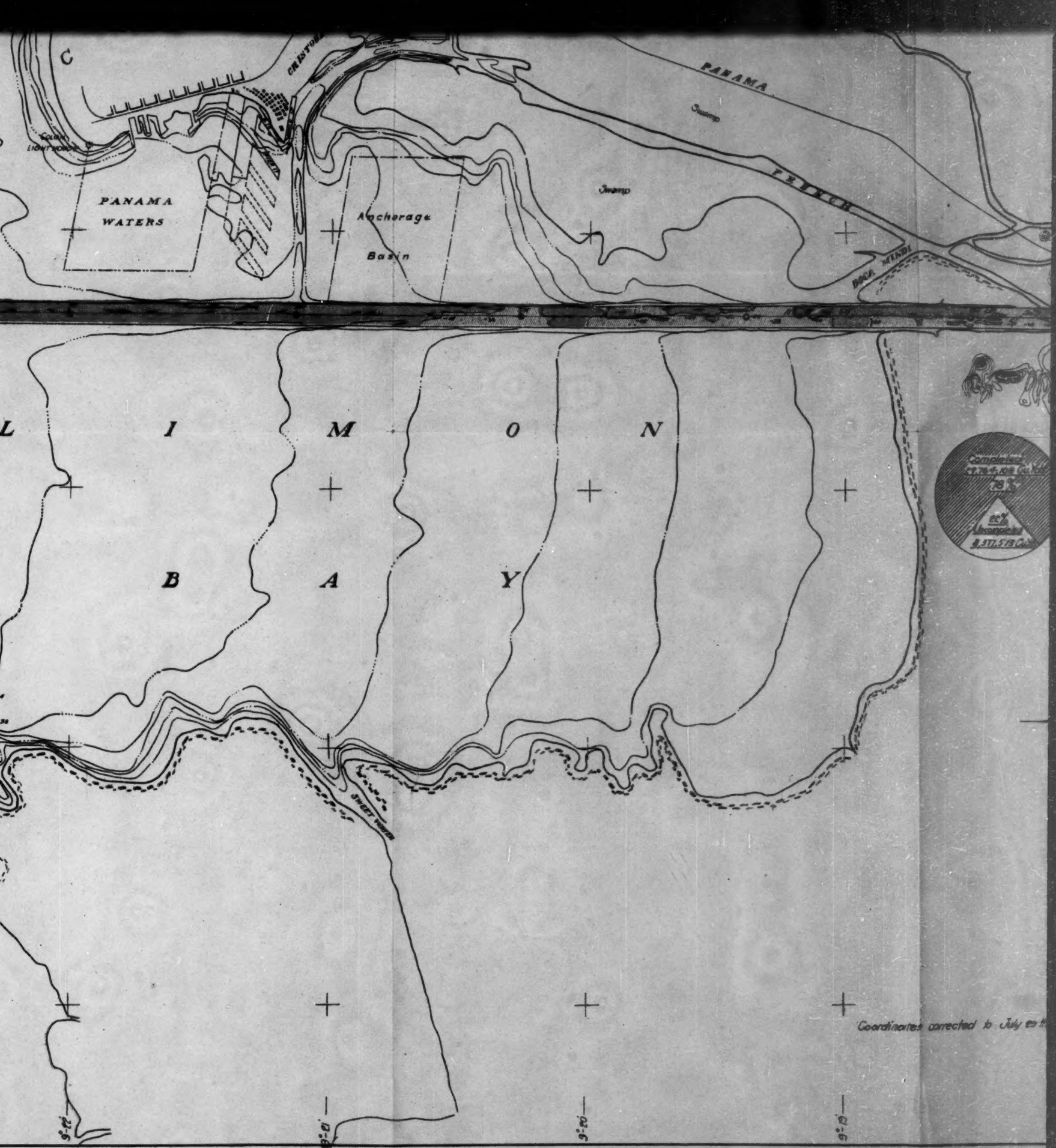
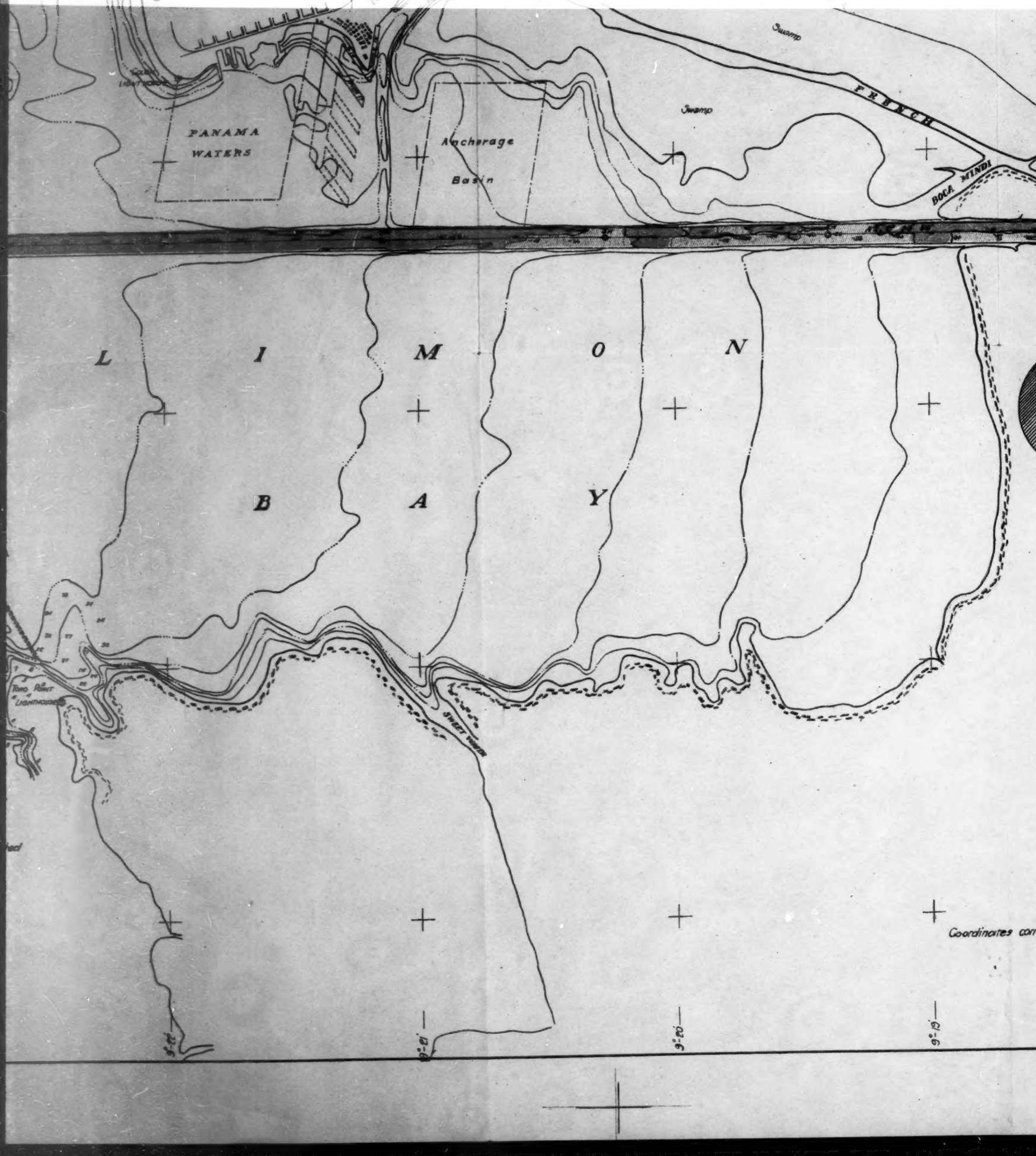

79° 56'
79° 54'
79° 52'
79° 50'
COLON
CRISTOBAL
MOUNT HOPE
Swamp
PANAMA
Swamp
FRENCH
Swamp
PANAMA WATERS
Anchorage Basin
BOCA MINDI
LIMON BAY

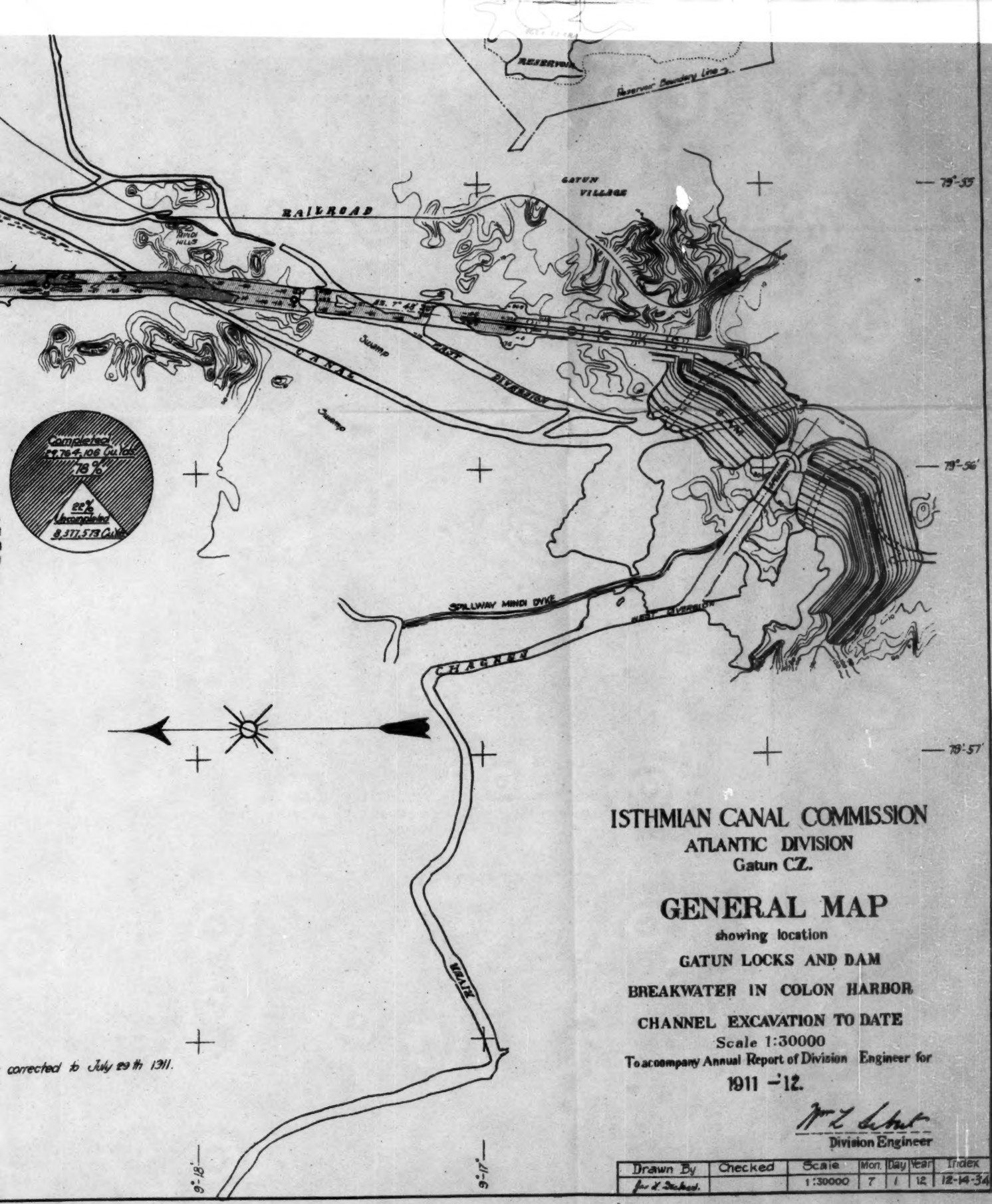
Plate 78.


9°-15'
9°-17'
9°-16'
79°-58'
79°-54'
79°-55'
79°-56'
Reservoir Boundary Line
GATUN
VILLAGE
RAILROAD
MINDI
HILLS
CANAL
Swamp
EAST
BAY ENTRY
Completed
27,764,106 Cu Yds
78 %
22 %
Uncompleted
8,377,513 Cu Yds
SPILLWAY MINDI DYKE
CHAGRES


79°-55'
79°-56'
79°-57'
79°-58'
93°-25'
93°-25'
Front of Trestle - June 30, 1911
Toro Point Lighthouse
Cross Section West Breakwater
Scale 1"=40'
Sea Side
Slope 1 on 2
Slope 1 on 1.5
Porto Bello Rock
Toro Point Rock
Mean Sea Level
Slope 1 on 1.5
1'-6"
Completed
Breakwater 54% completed
THE LORD BALTO PRESS, BALTO. MD


C
CRISTOBAL
PANAMA
Swamp
FRENCH
Swamp
PANAMA
WATERS
Anchorage
Basin
BOCA MIRADI
L I M O N
B A Y
Completed
Incomplete
Coordinates corrected to July


PANAMA
WATERS
Anchorage
Basin
Swamp
Swamp
FRENCH
BOCA MINDI
L I M O N
B A Y
Toro Point
Lighthouse
Street Tower
Coordinates con



corrected to July 29th 1911.

ISTHMIAN CANAL COMMISSION

ATLANTIC DIVISION

Gatun C.Z.

GENERAL MAP

showing location

GATUN LOCKS AND DAM

BREAKWATER IN COLON HARBOR

CHANNEL EXCAVATION TO DATE

Scale 1:30000

To accompany Annual Report of Division Engineer for

1911 – 12.

Wm L Sibert

Division Engineer

Drawn By	Checked	Scale	Mon.	Day	Year	Index
Jas. H. Dickson.		1:30000	7	1	12	12-14-34

Camino de Cruces

Cardenas

Panama-Corozal Road

Camino de Pedro Miguel Road

Corozal

Miraflores Dump

Panama R.R.

16 Water Supply Line

Miraflores

Pedro Miguel

Miraflores Lake

Surface Elevation +55

Grande

Rio

Arraijan

Camino de

Cocoli

Rio

Camino de Velazquez y Cochinito

Rio Velazquez

SCALE IN

Pedro Miguel Lock Site

Miraflores Locks Site

EXCAVATION D

Showing

Volumes Expressed i

Excavation done in the time previous to June 30, 1907. July 1, 1907 to June 30, 1908 July 1, 1908 to June 30, 09. July 1, 1909 to June 30, 1910. To be excavated

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Plate 107

ISTHMIAN CANAL COMMISSION
PACIFIC DIVISION

PEDRO MIGUEL TO PANAMA BAY

OFFICE OF DIVISION ENGINEER CORDEAL
SCALE 1:40000 DATE JUNE 30, 1910
DRAWN BY Bladen TRACED BY Bladen CHECKED BY Hanna
To accompany Annual Report for Fiscal Year ending June 30, 1910

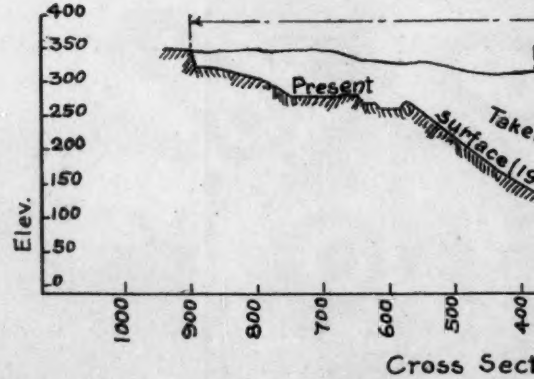
Approved: S. B. Williamson
Division Engineer

PUNTA PATILLA
PANAMA
ANCON
EAST BALBOA
BALBOA
Rio Grande
Zone Line
Line of Range
Breakwater to Naos Island
NAOS I.
PERICO I.
FLAMENCO I.
CULEBRA I.
CHAMBARDS I.
OCEAN
PACIFIC
Rio Farfan
LE IN FEET
1000 2000 4000 5000

N DIAGRAM
wing
ssed in Sq. In.
2200 2300 2400 2500
Excess Dredging shown, due to Slippage
avated
Scales { Horizontal 1 Ft. = 40,000 Ft.
Vertical 1 In. = 20,000 Ft.
Areas 1 Sq. In. = 2,469,136 Sq. Ins.

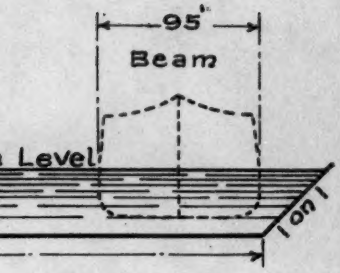
Mindi River to Gatun Locks Mile 4
Miraflores to Panama Bay Mile 41.4

Gatun Locks t



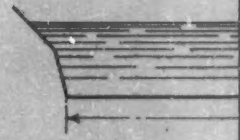
Cross Sect

THE LORD BALTO PRESS, BALTO. MD.



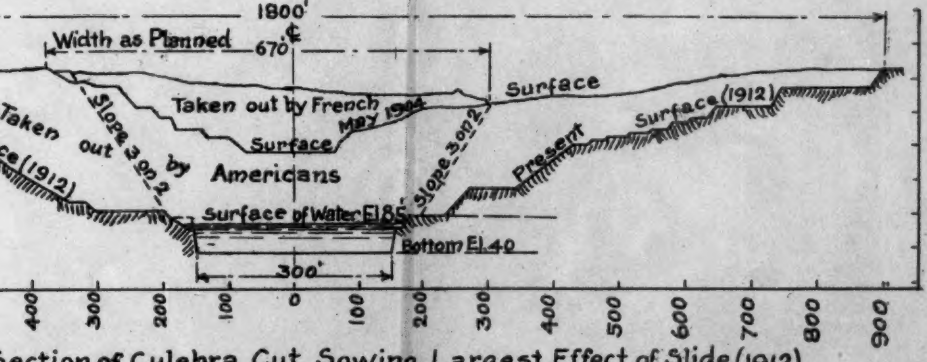
le 4.5 to 7.15
41.47 to 45.5

Colon Harbor Mile 0 to 4.5



ks to Angle North of San Pablo Mile 7.74 to 23.66

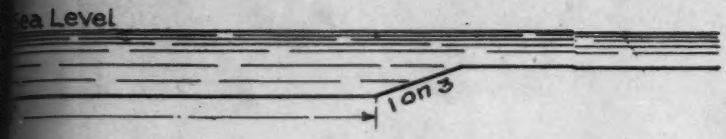
Angle North of



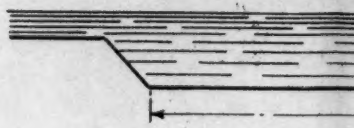
Section of Culebra Cut Sowing Largest Effect of Slide (1912)

PANAM

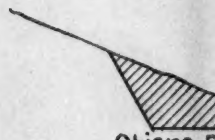
CROSS S



Mile 0 to 4.5



Angle

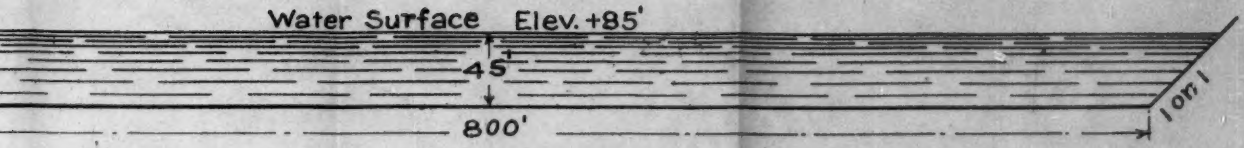


Obispo

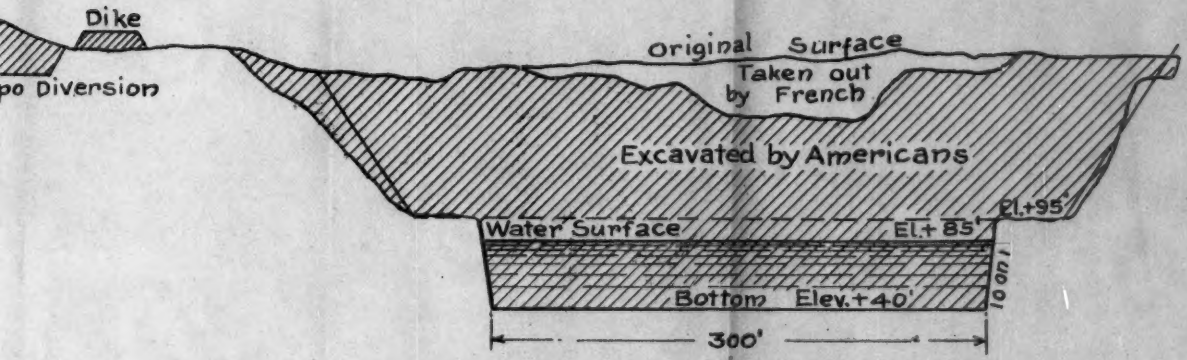
Angle North of Juan Grande to Angle at Bas Obispo Mile 27.5 to 31.5

PANAMA CANAL

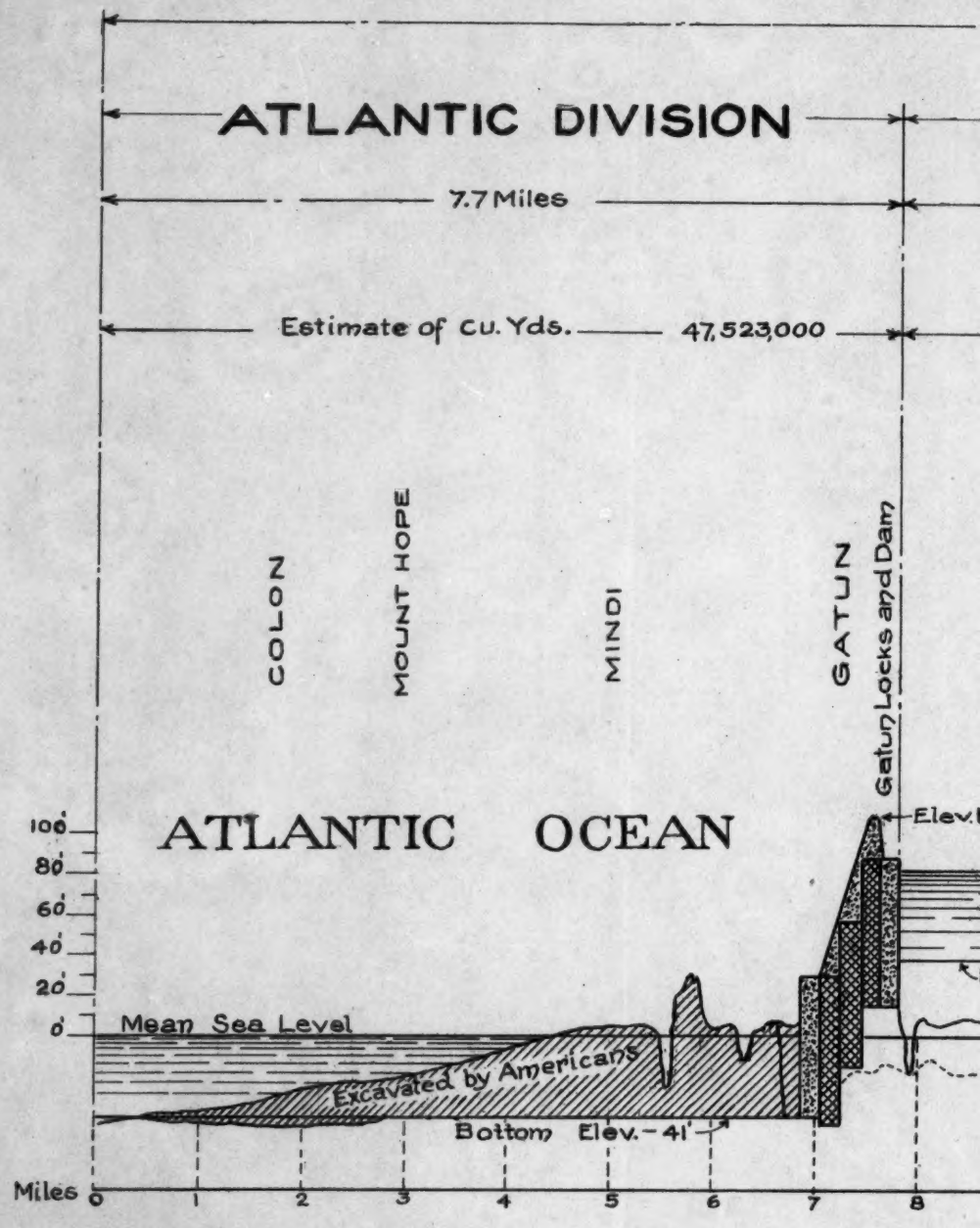
CROSS SECTIONS



gle North of San Pablo to Angle North of Juan Grande Mile 23.66 to 27.5



Typical Cross Section of Culebra Cut
Bas Obispo, Mile 31.5 to Pedro Miguel, Mile 39.6


ATLANTIC DIVISION
7.7 Miles
Estimate of cu. Yds. 47,523,000
COLON
MOUNT HOPE
MINDI
GATUN
Gatun Locks and Dam
ATLANTIC OCEAN
100'
80'
60'
40'
20'
0'
Mean Sea Level
Excavated by Americans
Bottom Elev. - 41'
Miles
0
1
2
3
4
5
6
7
8

Estimate of Cu. Yds.

CENTRAL DIV

31.7 Miles

Estimate of Cu. Yds.

LION HILL

AHORCA LAGARTO

PENA BLANCA

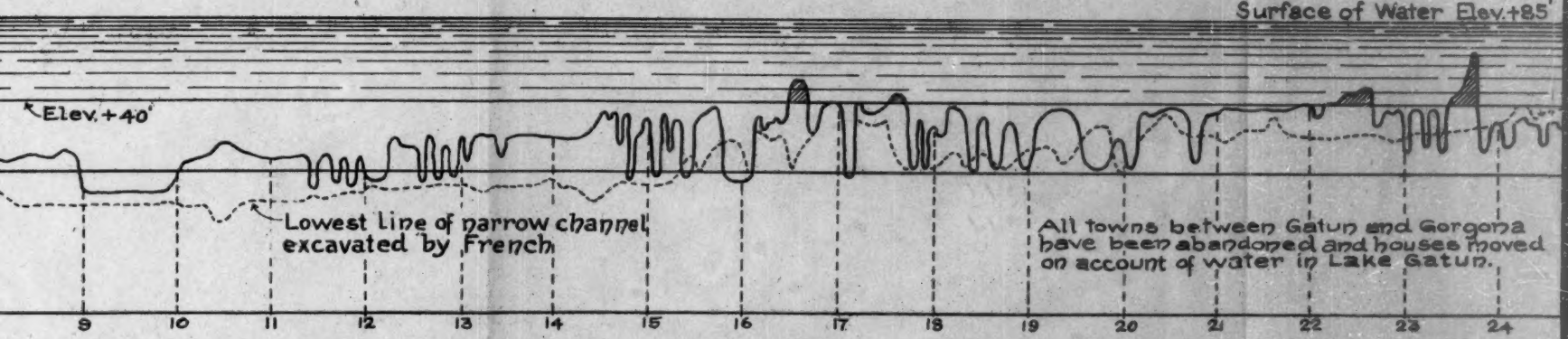
BOHIO

BUENA VISTA

FRIJOLES

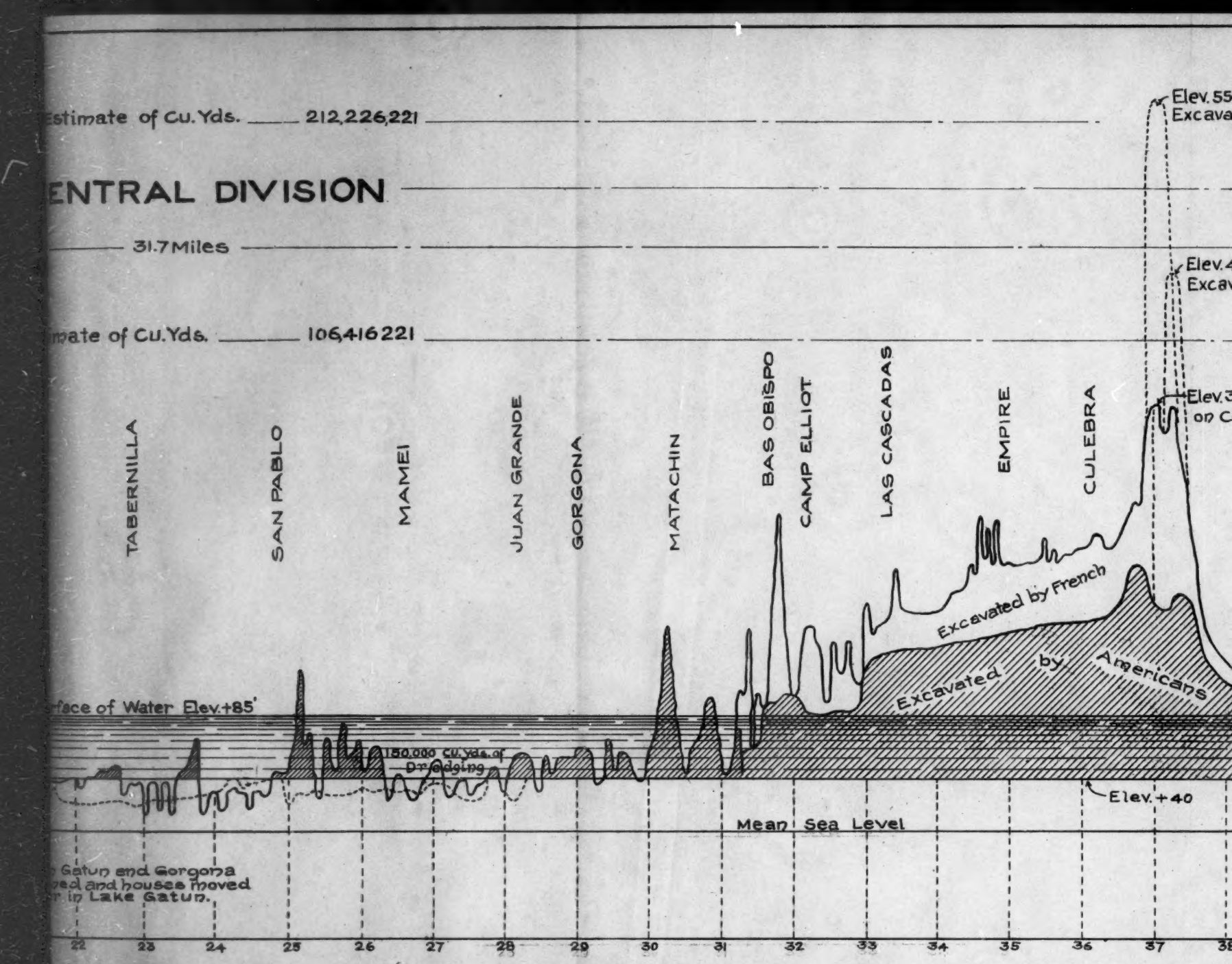
TABERNILLA

lev. 105'



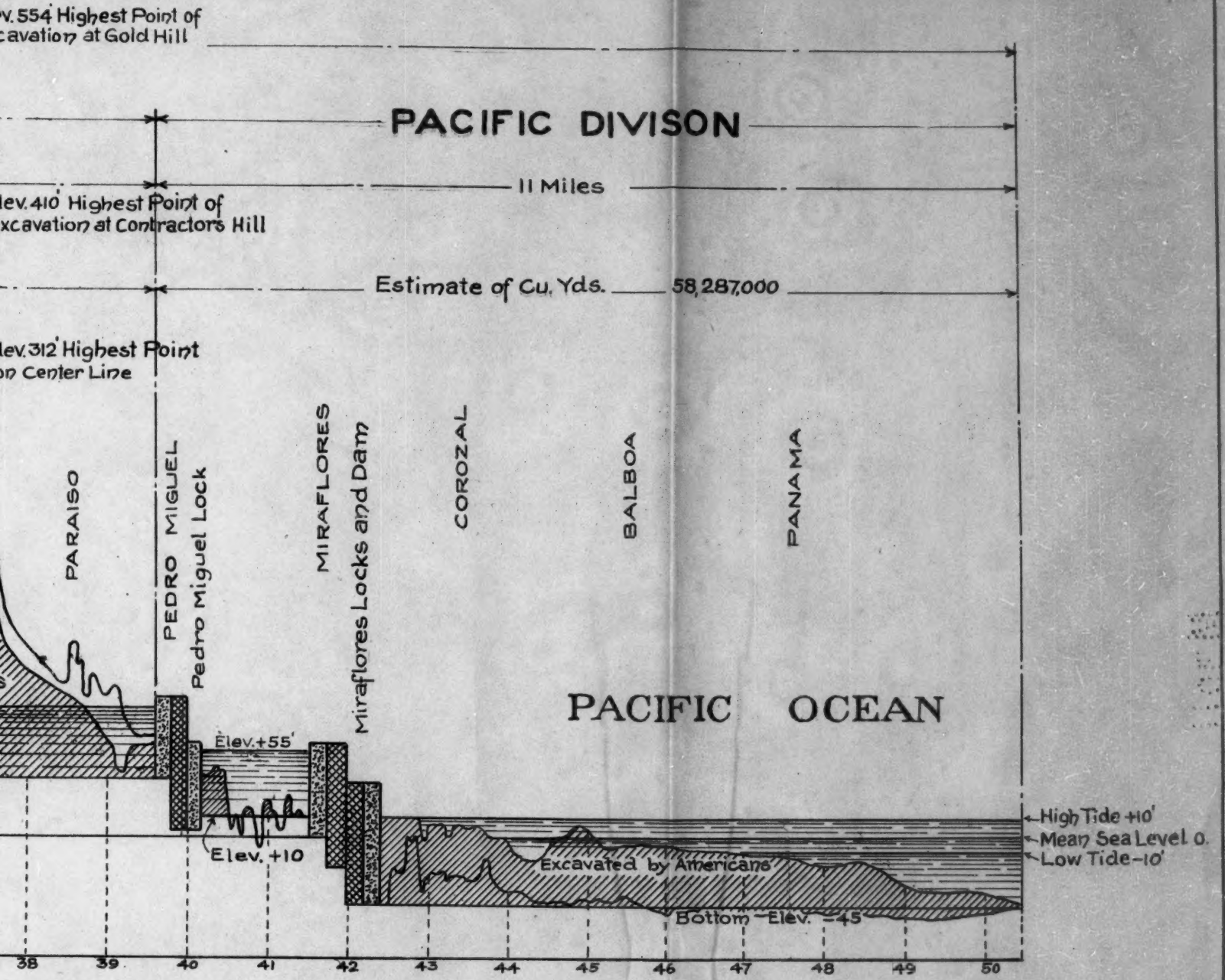
PANAMA CA

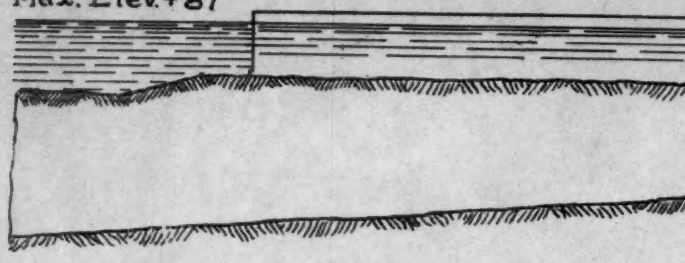
VERTICAL SCALE 100

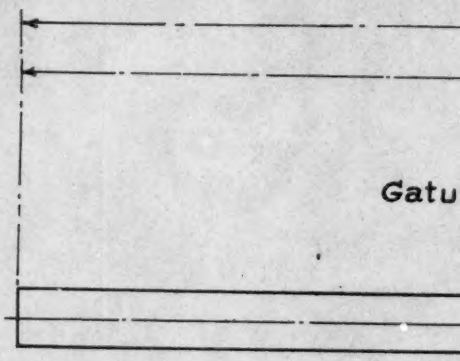


NAMA CANAL—PROFILE

ERTICAL SCALE 100 TIMES HORIZONTAL SCALE


v. 554 Highest Point of
cavation at Gold Hill
PACIFIC DIVISON
11 Miles
lev. 410' Highest Point of
xcavation at Contractors Hill
Estimate of Cu. Yds. 58,287,000
lev. 312' Highest Point
on Center Line
PARAISO
PEDRO MIGUEL
Pedro Miguel Lock
MIRAFLORES
Miraflores Locks and Dam
COROZAL
BALBOA
PANAMA
PACIFIC OCEAN
Elev. +55'
Elev. +10
Excavated by Americans
Bottom Elev. -45
High Tide +10'
Mean Sea Level 0.
Low Tide -10'
38
39
40
41
42
43
44
45
46
47
48
49
50





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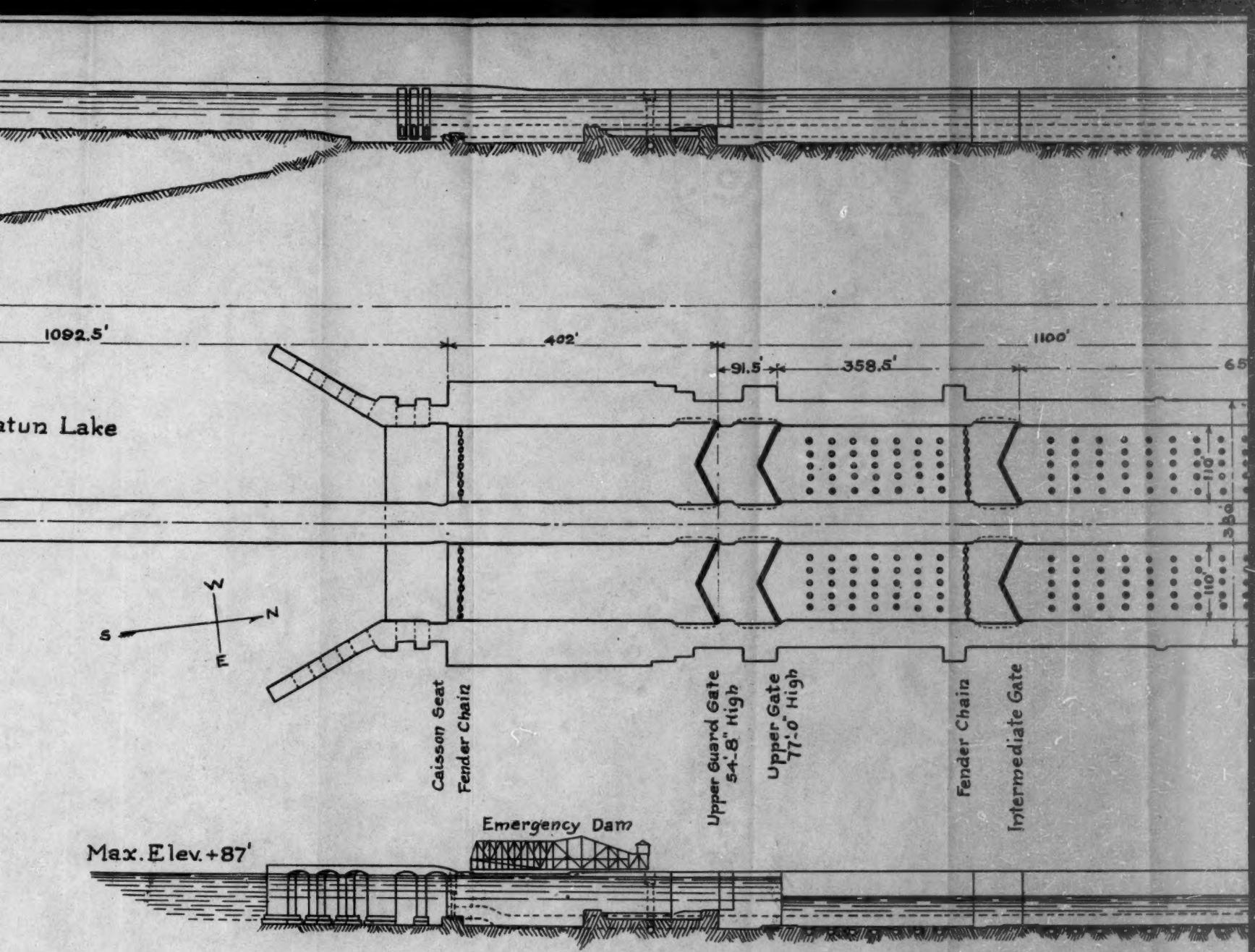
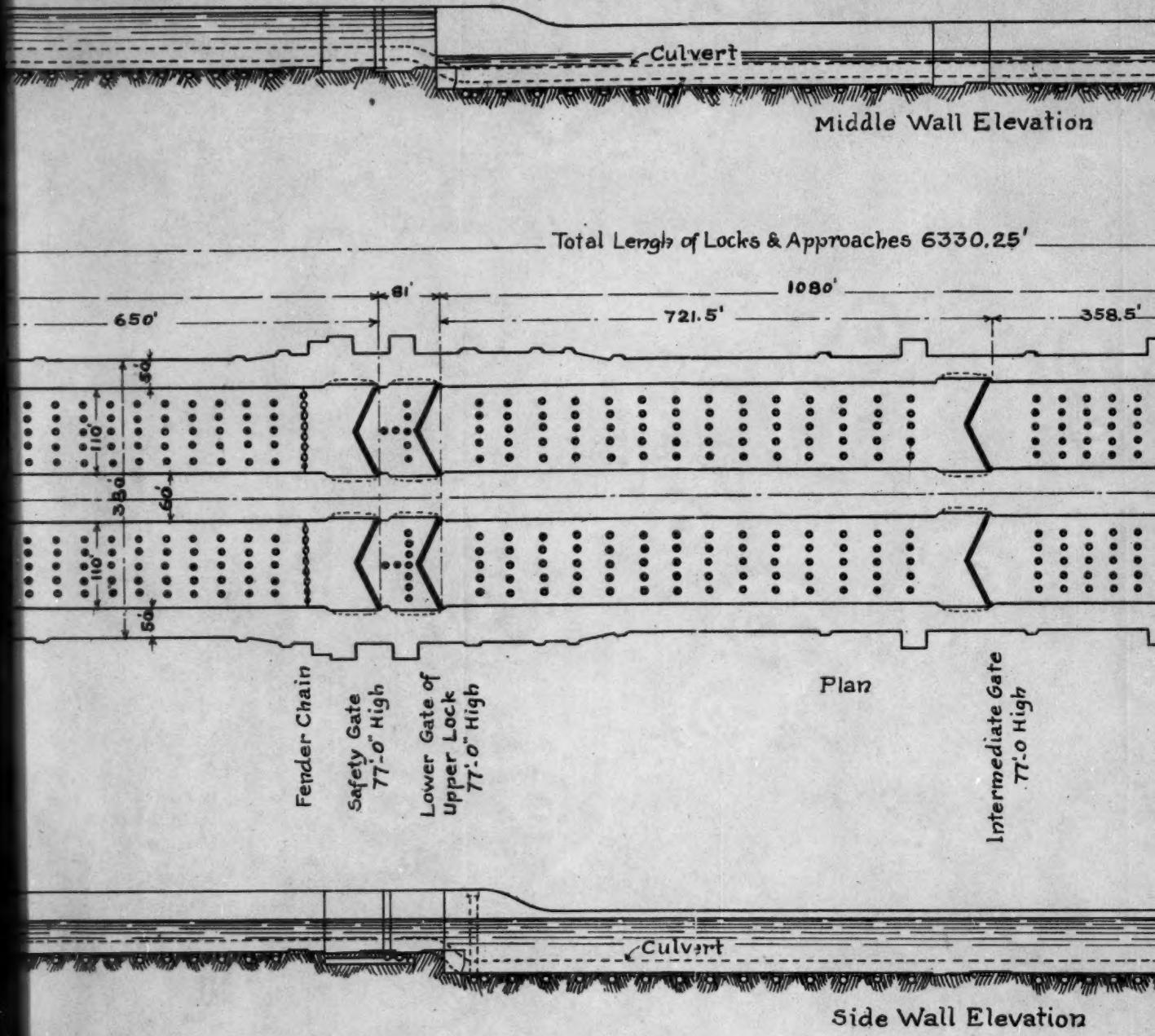
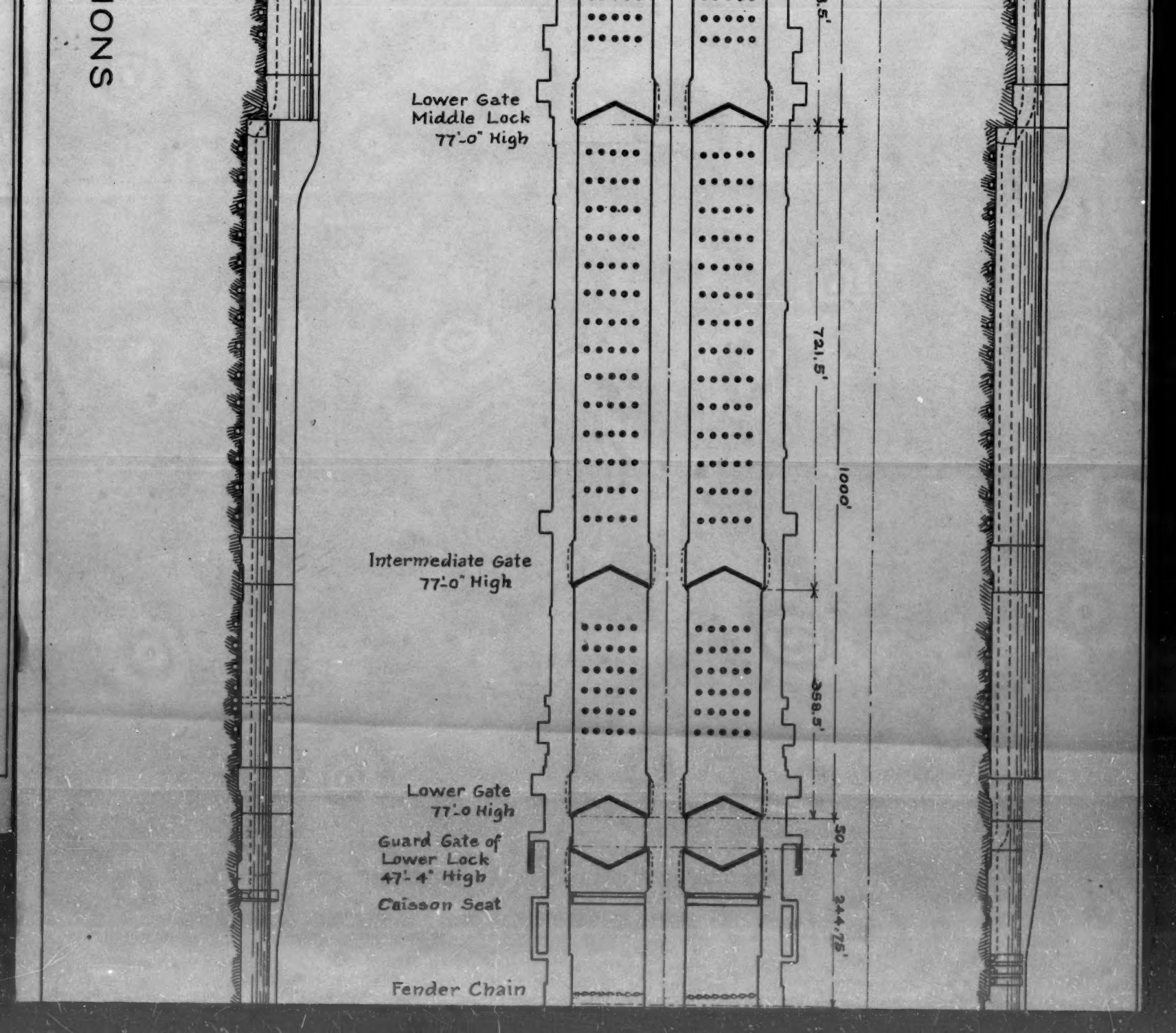

1092.5'
402'
91.5'
358.5'
1100'
65
atun Lake
110'
110'
380
N
S
E
W
Caisson Seat
Fender Chain
Upper Guard Gate
54'-8" High
Upper Gate
77'-0" High
Fender Chain
Intermediate Gate
Emergency Dam
Max. Elev. +87'

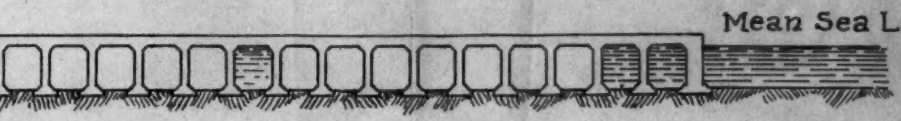


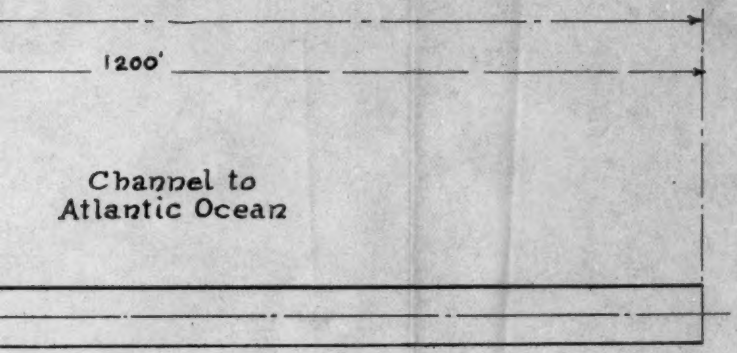
GATUN LOCKS

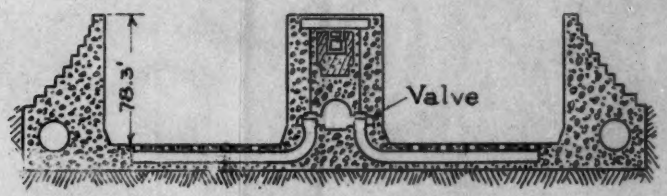
GENERAL PLAN, PROFILES & SECTIO


SNO
Lower Gate
Middle Lock
77'-0" High
Intermediate Gate
77'-0" High
Lower Gate
77'-0 High
Guard Gate of
Lower Lock
47'-4" High
Caisson Seat
Fender Chain
721.5'
1000'
358.5'
50'
244.75'

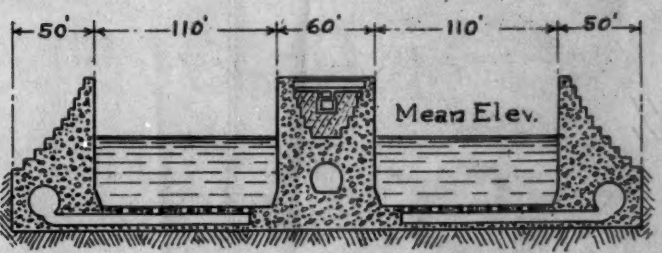
1000'
358.5'
50
244.75'
Intermediate Gate
77'-0" High
Lower Gate
77'-0 High
Guard Gate of
Lower Lock
47'-4" High
Caisson Seat
Fender Chain
Mean Elev.±0







Section



Section

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE COLT'S AUTOMATIC REVOLVER AND THE INSTRUCTION OF MEN IN ITS USE.

By ENSIGN C. E. VAN HOOK, U. S. Navy.

The fleet has recently been supplied with a new weapon in the way of small arms, and the writer feels that a few remarks upon its advantages and its use may not come amiss at this time. The 45 caliber Colt's automatic revolver has been received by the navy with more or less suspicion, simply because it is a radical departure from the six-shooter type of gun. The newest recruit takes naturally to the old type—it is the kind of weapon with which he has been more or less familiar from his earliest boyhood, but when he first takes an automatic in his hand he feels about as much at home as a fish out of water. As it is an entirely new departure nearly everybody is ignorant of its operation and its advantages, hence these notes.

To begin with, the automatic has the following advantages over the weapon it supersedes:

1. It is of greater caliber and may be depended on to "stop" a man, where the 38 caliber would not immediately disable him.

2. It may be loaded with greater ease and rapidity. This takes into consideration the fact that under service conditions a number of extra clips, loaded and ready for instant use, would be carried in a specially designed belt.

By actual test the interval between the last shot of one string, and the first shot of the next, is only five seconds. This can only be done, of course, by holding an extra clip in the left hand, ready for loading. There need never be any doubt about when the end of the string is reached, for the gun is so constructed that the breech remains open after the last shot—that is, the slide does not "return to battery."

3. It has a heavier barrel, and lends itself more readily to steady aim.

4. The trigger pull always remains the same, which is a decided advantage over the disconcerting double action of the 38 caliber, and makes it a great deal more accurate for rapid firing.

5. It is fitted with a safety device that makes it absolutely safe from accidental discharge.

PRECAUTIONS.

The general precautions necessary in the use of any revolver are well known in the service. A day spent on the revolver ranges at Guantanamo is enough to convince the most optimistic that they are not particularly well observed, and that there is truth in the saying that "eternal vigilance is the only price of safety."

A brief summary of special precautions to be observed in the use of the automatic is given as follows:

1. The revolver should be left on the firing line, breech open and clip out, when not actually in use.

2. Men should never be allowed to leave the firing point during, or between strings. Extra clips should be supplied, and empties taken away, by gunner's mates or others detailed for the duty.

3. When returning the slide to battery after loading a new clip, the finger must be kept clear of the trigger.

4. As the clips hold seven rounds, and the string consists of only six, the clips should be loaded by reliable gunner's mates. There is always the danger of one round remaining in the gun. The men should be impressed with the fact that the end of the string is marked by the breech remaining open, and that the gun is loaded and dangerous until that time. Even after the usual instruction some men, thinking that they have finished the string at the fifth shot, have ejected the empty clip and left the revolver on the firing line with the sixth round still in the chamber. The sure remedy for this mistake, and a precaution that should always be insisted on, is to draw back and ease down the slide and then snap the revolver at the target, thus making sure that both clip and chamber are empty.

5. It should be carefully explained that the action of the revolver is entirely automatic and that, after inserting a loaded clip and inserting the first round into the chamber, all that is necessary is to pull the trigger until the gun is empty. One man was found working the slide after each shot to load the gun again. The

result was that out of the six rounds loaded into the clip, he got only three shots, every alternate round being ejected as he "loaded the gun again."

So much for the special precautions to be observed. The next thing is to consider the instruction of the men in its use.

INSTRUCTION OF MEN.

It should generally be assumed that the man about to shoot is entirely ignorant of the operation of the new gun. The writer's personal experience is that, at the present time, the assumption is justified in about ninety-nine cases out of a hundred. Suppose we consider that the man has never had an automatic in his hand before and knows nothing about it. The following instruction is recommended:

1. Take the revolver in your right hand and the clip in your left. Show him how to insert the clip, trip the slide, inject the first round into the chamber, etc.

2. Show him a little sketch of the way in which the front sight should be brought half way up the notch of the rear sight, and just under the bull. Tell him to take sight as explained and then to count ten to himself, squeezing the trigger firmly as he does so. This counting has a remarkable effect on steadying the trigger pull and therefore on steadying the aim. It must be given a trial to be fully appreciated. The gun usually goes off a little before it is expected to, and therefore the aim is not disconcerted by flinching, or by a quick pull on the trigger. The term "trigger pull," by the way, is a misnomer. No one can ever do good work if he is going to "pull" the trigger. The gun must be discharged by a uniformly increasing pressure of the whole hand.

3. The best position for firing the automatic differs in no way from that used in firing the old style Colt's. Owing to the automatic action and the increased caliber, there is a little more recoil. The revolver should be held at arm's length and the recoil taken by allowing the whole arm to fly up. A bent elbow, or taking the recoil at the wrist, is generally fatal to accuracy.

4. The automatic ejects the shells with some force to the rear and to the right, and, as they are hot when they come from the gun, to be struck in the face by one is not a very pleasant experience. It is therefore recommended that the instructor should take up his position to the left and slightly in the rear of the man

who is firing. From this position he is best able to watch a right-handed man and to correct errors in position, aiming, and trigger pull.

It has been the writer's experience that green men with absolutely no previous knowledge of the automatic revolver respond remarkably to such instruction, and especially to coaching during their strings. By coaching is meant continually warning the man to steady under the bull and to squeeze the trigger instead of pulling it. Assure the man that if he will do exactly as told he will get a bull every shot without fail, and then if he does not get it, explain clearly to him wherein he failed to carry out instructions.

Great patience and interest in the instruction of men is, of course, as necessary in this field as in any other. All criticism used should be helpful criticism and a man should never be allowed to get the idea into his head that his officers have given him up as hopeless. If he once gets that idea he rapidly becomes hopeless.

If he does poor work on the range there is a reason, and it should be a matter of professional pride to his instructor to find out and correct the fault. We have all had experience with the man who seems to be utterly unable to hit the target, and we have all felt like telling him that he couldn't hit a barrel even if he were inside of it. And we have all seen many such men, after careful instruction and a little practice, surprise everybody by making a fairly good score. It is not anything to be surprised about. "There's a reason" for that too, and the reason is that somebody did not give that man up as hopeless—somebody stayed with him and did his duty as an instructor.

There is no mean satisfaction in making a marksman out of such a man, or any other, for that matter. When we have broken him in we can feel that we have added one more gun to the nation's defence in time of need.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE PROBLEM OF FIRING AT A FLEET UNDER WAY WITH LONG-RANGE TORPEDOES.

By ENSIGN H. H. FROST, U. S. Navy.

The firing of torpedoes in action can be divided into two separate problems: first, firing at a single ship; and, second, at a fleet or number of ships in formation.

There are few cases in battle where a torpedo would be fired with a single ship as a target. To be able to have a fair chance of hitting a single ship, the range must be very small. At 3000 yards an error of either one knot in the estimation of the speed of the target or ten degrees in its course is sufficient to make the torpedo miss, even though it make a perfectly straight run. The only class of ship that could plot the target's speed and course sufficiently accurately to fire at this range would be the battleship or destroyer in a day action, and the possibility of either ship being so close to the target is remote and can be neglected. The only cases left of firing at a single ship would be those of a destroyer at night or a submarine during the day. In both these cases it would be impossible to do more than guess at the course and speed of the target; and to have a fair chance of hitting, the range could not be more than 1000 yards. Thus it is seen that the problem of firing at a single ship is not important.

The second problem, that of firing at a number of ships in formation, is very important and includes nearly every case of firing in action. Battleships and destroyers in a day action can hardly expect to get within 6000 yards of the target and at this range it would be impossible to hit a single ship. Destroyers in a night attack, with the present methods of defense used by fleets, will find great difficulty in getting as close as 2000 yards to their target, will be unable to do any plotting, and if discovered will not last

long at this range; so they cannot wait to single out one ship as a target, but must fire at the enemy's whole fleet. Thus nearly every case of firing in action will be at a number of ships in formation.

It is the purpose of this article to examine this problem very carefully and to determine accurately the most advantageous positions from which torpedoes can be fired at a fleet under way. These positions depend on three conditions as follows: First, the position must be such that a torpedo fired from it will reach the target, having in mind that, while the torpedo is under way, the enemy will also be under way, either toward or away from the torpedo. Second, the position must be such that the enemy's fleet will offer a target so large that any torpedo functioning perfectly should pass between the end ships of his formation. Third, the position should be such that, assuming the torpedo to pass between the end ships of his formation, there will be the greatest chance of actually hitting a ship, and the least chance of passing through the open water between ships. As a rule it will not be possible to fulfil all these conditions. It is absolutely necessary that the first be fulfilled, and of the other two we must judge which is the more important in the various cases that may arise. First we will examine each of the three conditions, and will then show how they should be combined to give the greatest chance of scoring a hit in the actual cases that would be presented in battle. We will assume, in all discussion in this article, unless where stated otherwise, the following:

Range of torpedo	10,000 yards
Speed of torpedo	25 knots
Speed of target	15 knots
Interval between target ships	500 yards

The width of the target will be measured in degrees; that is, if we say a target is 15 degrees wide, it will mean that the angle at the firing ship subtended between the end ships of the target is 15 degrees.

Examining the first condition, it is evident, as a general rule, that if the firing ship is forward of the enemy's beam it will be able to launch torpedoes at a greater range than 10,000 yards, while if it is abaft the enemy's beam it will be necessary to fire them at a range of less than 10,000 yards. To run 10,000 yards at 25 knots takes a torpedo 12 minutes, during which time the target

at 15 knots will go 6000 yards. If the target is steaming directly toward the firing ship, a torpedo launched at 16,000 yards will reach the target, while if the target is steaming directly away, it will be necessary to get as close as 4000 yards to fire a torpedo which will overtake it.

In Fig. 1 let A be the position of the firing ship, B that of the target and angle x the target's course with reference to the line AB. Lay off on cross-section paper BC equal to 6000 yards. With C

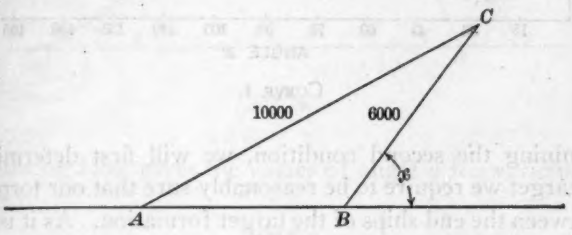


FIG. 1.

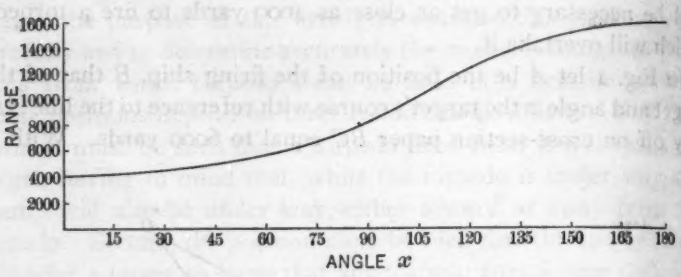
as a center and 10,000 yards as a radius, strike an arc cutting AB at A. Measure AB, which is the greatest distance at which a torpedo may be fired with the course (x) given. Using various values for this course, the following table is made:

TABLE 1.

Angle x.	Maximum range of torpedo.
0	4,000
15	4,100
30	4,400
45	4,800
60	5,600
75	6,600
90	8,000
105	9,700
120	11,600
135	13,300
150	14,800
165	15,700
180	16,000

This table shows that if we wish to fire at long range we must not take a position abaft the beam of the target ships.

Using the values found in Table 1, the following curve is drawn:



CURVE 1.

Examining the second condition, we will first determine how wide a target we require to be reasonably sure that our torpedo will pass between the end ships of the target formation. As it is evident that, when the course of the torpedo is at right angles to the line of bearing of the target ships, a large target will be presented, while if its course makes a small angle with the line of bearing, the target will be presented more or less end on and its width will be much decreased, and as it is of advantage, for other reasons, that the course of the torpedo make as small an angle as possible with the line of bearing of the target ships, we will next find the smallest angle which will give the required width of target for various numbers of ships in the enemy's formation.

When firing at a moving target it is necessary to set the torpedo director for the following: speed of torpedo, speed of target and course of target. We will assume that the speed of torpedo has been found by trial shots to be 25 knots. For this torpedo to travel 10,000 yards, it will take 12 minutes. We will assume that in plotting the speed of the target we will not make an error of more than one knot. A vessel going at a speed of one knot for 12 minutes will travel 400 yards. We will now calculate the angular error in degrees this faulty estimation of the target's speed will cause, for various courses of the target.

In Fig. 2 let B be the position of the target and BC (angle x) its course. Lay off BC equal to 6000 yards, and with C as a center and a radius of 10,000 yards strike an arc cutting AB at A. Lay

off *CD* equal to 400 yards. Then angle *y* is the error caused by the mistake of one knot in the estimation of the target's speed.

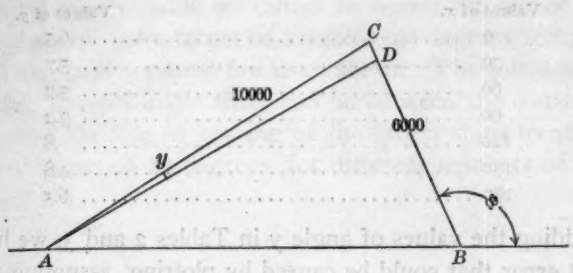


FIG. 2.

The following table gives the values of angle *y* for various values of angle *x*.

TABLE 2.

Values of *x*.	Values of *y*.
0	0
30	.3
60	.8
90	1.6
120	2.0
150	1.6
180	0

Next we will assume that the course of the enemy can be determined within 12 degrees. In Fig. 3, *AC* is the course as estimated

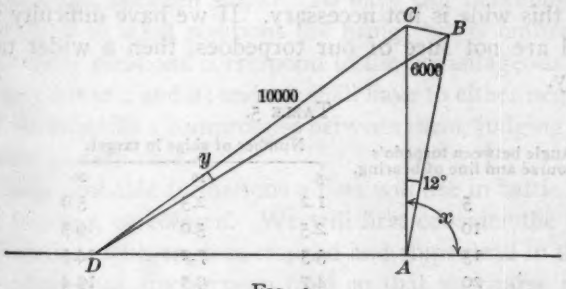


FIG. 3.

and *AB* is the actual course. $AB = AC = 6000$ yards, $CD = 10{,}000$ yards. Angle *y* is the error caused by the incorrect estimation of

the course of the target. The following table is made for various values of angle x.

TABLE 3.

Values of x.	Values of y.
0	6.5
30	5.7
60	5.7
90	3.2
120	.8
150	4.8
180	6.5

By adding the values of angle y in Tables 2 and 3, we have the greatest error that could be caused by plotting, assuming that we can get the enemy's speed to within one knot and his course to within 12 degrees, which under average conditions we ought to be able to do.

TABLE 4.

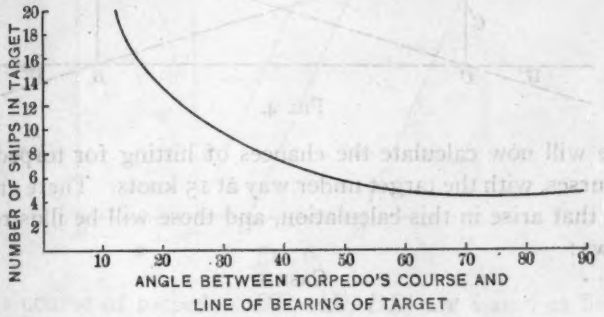
Values of x.	Values of y.
0	6.5
30	6.0
60	7.3
90	5.2
120	2.4
150	6.4
180	6.5

The errors for all courses but 120 are nearly the same, so by taking a target 14 degrees wide we can be reasonably sure that our torpedo will pass between its limits. If we can be sure that the plotting is correct, and satisfied that the torpedoes will run straight, a target this wide is not necessary. If we have difficulty in plotting and are not sure of our torpedoes, then a wider target is necessary.

TABLE 5.

Angle between torpedo's course and line of bearing.	Number of ships in target.		
	5	10	20
5	1.2	2.5	5.0
10	2.5	5.0	9.5
15	3.5	7.2	14.5
20	4.7	9.5	19.4
25	5.8	11.6	23.2
30	7.0	14.0	28.0
45	9.8	19.6	39.0
60	11.6	23.0	46.0
90	12.0	24.0	48.0

The preceding table shows the target in degrees presented by fleets of 5, 10, and 20 ships in the target formation, when the torpedo's course is at various angles to their line of bearing. To get a target 14 degrees wide we cannot be nearer the line of bearing than 15 degrees for a target of 20 ships, 30 degrees for 10 ships, and for five ships we must fire from abeam. The following curve shows the smallest angle there can be between the course of the torpedo and the line of bearing of the target ships to obtain the necessary target of 14 degrees, for different numbers of ships in the target.



CURVE 2.

Now we will take our third and probably most important condition; that is, assuming it possible to pass within the limits of the target, what position should the firing ship take so that, for various formations in the enemy's fleet, there is a maximum chance of hitting an enemy's ship and a minimum chance of passing through the open water between ships? To have this maximum chance, we will show to what positions the firing ship is limited and see whether these positions correspond to the advantageous positions shown in Curves 1 and 2; and we shall have to either neglect some conditions or strike a compromise between them, judging from the conditions in each case.

The only probable formations a fleet will use in battle are: line, line of bearing, or column. We will first consider the enemy in line formation, with engines stopped and ships dead in the water. It is evident that any torpedo fired so that its course makes an angle of 17 degrees or less with the line of bearing of the target ships will have a continuous target; that is, it will be certain of hitting a ship and cannot pass through the open water between

them, and a table can be made which will show the chances of hitting, for various courses of the torpedo. With the enemy's ships under way this table will not hold, for a torpedo on course AC (Fig. 4), just grazing the bow of ship AB, will pass well astern of the ship CD, because, while the torpedo is going AC the ship will have reached a new position, $C'D'$.

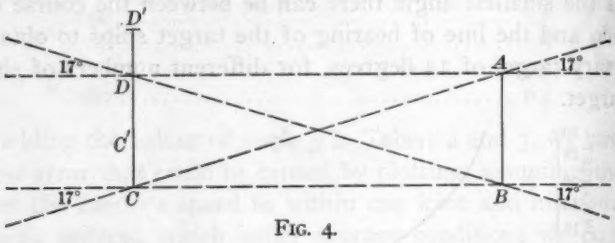


FIG. 4.

We will now calculate the chances of hitting for torpedoes on all courses, with the target under way at 15 knots. There are three cases that arise in this calculation, and these will be illustrated as follows:

CASE I.

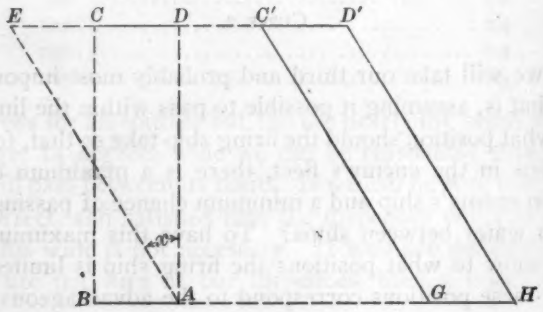


FIG. 5.

AB and CD are two ships in line and AE is the course of the torpedo.

$AD = 500$ and $AB = CD = 150$.

(1) $ED = 500 \tan x$.

$EA = 500 \sec x$.

(2) $C'D'$ is the position of the ship CD when the torpedo reaches E and $CC' = DD' = 15/25\ EA$, as speed of torpedo is 25 and speed of ship is 15 knots.

(3) $EC' = CC' - CD + ED$.
(4) Make $AG = EC'$, and $GH = C'D' = 150$.
(5) A torpedo passing through AG will not hit.
A torpedo passing through GH will hit.
(6) Therefore the chances of hitting are GH/AH.

CASE 2.

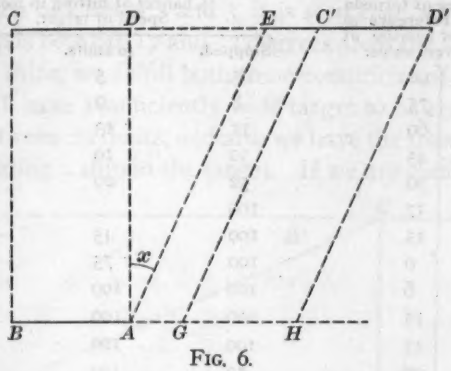


FIG. 6.

AE is course of torpedo. DE, AD, DD' are found as before. $AG = EC'$, $GH = C'D$.

(1) A torpedo passing through AG will not hit.
(2) A torpedo passing through GH will hit.
(3) Therefore the chances of hitting are GH/AH.

CASE 3.

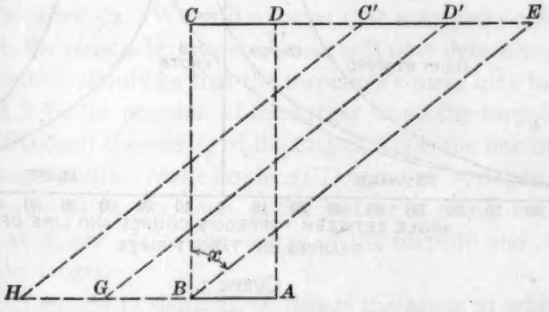


FIG. 7.

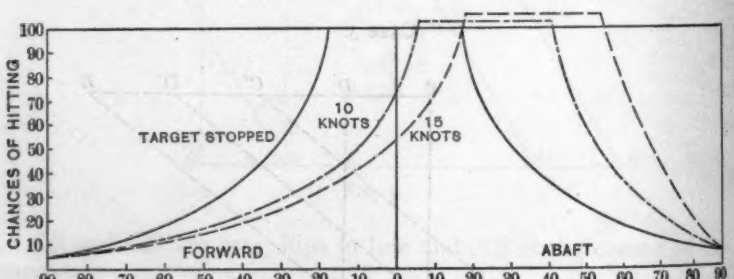
BE is the course of the torpedo. CE, BE, CC' are found as before, and torpedo arrives at E when the ship CD arrives at $C'D'$. Make $GB = D'E$ and $HG = C'D'$.

(1) A torpedo passing through GB will not hit.
(2) A torpedo passing through HG will hit.
(3) Therefore the chances of hitting are HG/HB.

A table is calculated and a curve drawn for speeds of the enemy of 10 and 15 knots, using various values for angle x.

TABLE 6.

	Course of torpedo with reference to line of bearing of target ships.	Chances of hitting in 100. Speed of target.		
		Stopped.	10 knots.	15 knots.
Ahead of line	90	5	5	5
	75	8	9	8
	60	17	13	11
	45	30	19	16
	30	52	29	23
	17	100		
	15	100	45	35
Abaft line	0	100	75	50
	6	100	100	
	15	100	100	86
	17	100	100	100
	30	52	100	100
	39		100	100
	45	30	70	100
	52			100
	60	17	33	74
	75	8	14	20
	90	5	5	5



CURVE 3.

From the curve it is seen that, when the target is stopped, a continuous target is presented when the torpedo's course is within a sector from 17 degrees forward to 17 degrees abaft the line of

bearing, 34 degrees in all. When under way at 10 knots, this sector extends from 6 to 39 degrees abaft the line of bearing, and at 15 knots from 17 to 52 degrees abaft the line of bearing. Thus the sector is always about 34 degrees wide, and the only effect the speed of the target has upon it is to move it farther abaft the line of bearing as the speed increases. Assuming the speed of the enemy to be 15 knots and that there are 20 ships in his fleet, then, by examination of Curves 2 and 3, it is seen that, when the course of the torpedo is between 17 and 52 degrees abaft the line of bearing of the target ships, we fulfill both these conditions of the problem; this is, we will have a sufficiently wide target to be reasonably sure of passing between its limits, and also we have the maximum chance of actually hitting a ship in the target. If we are confident that we

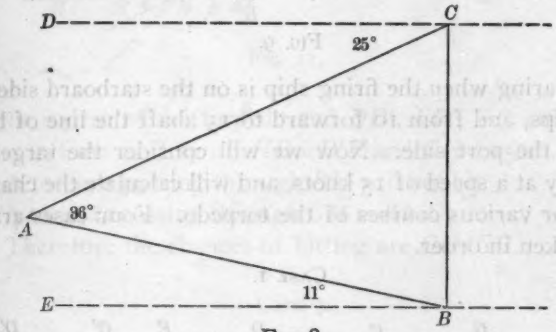


FIG. 8.

can hit a target 14 degrees wide, then there is advantage of firing at 17 degrees, for it will give us a greater range than if the torpedo's course were 52. We will assume that a torpedo course of 25 degrees is the most advantageous, and will now determine what the ship's position should be that the torpedo's course may be such. In Fig. 8 let *B* be the position of the target when the torpedo was fired, and *CB* (6000) the course of the target, *CD* is the line of bearing of the target ships. Make angle *ACD* equal to 25 degrees, and lay off *AC* equal to 10,000; then, at the instant of firing, the firing ship will be at *A*, and *AC* is the course of the torpedo and *AB* the bearing of the target.

Angle *ABE* equals 11 degrees, so this is the angle at which the firing ship should be ahead of the line of bearing of the target ships, to fire torpedoes with the maximum chances of hitting a ship in the target. By examination of Curve 1, it is seen that the maximum range at which a torpedo can be fired is 9500 yards.

Now we will consider the target ships to be in a 45-degree line of bearing, and will first take the case when they are stopped. In Fig. 9, AB and CD are two ships in formation. $DB=AC=500$ yards. $ED=EB=350$ yards. $CD=AB=150$. A continuous target is presented from 15 degrees forward to 10 degrees abaft the

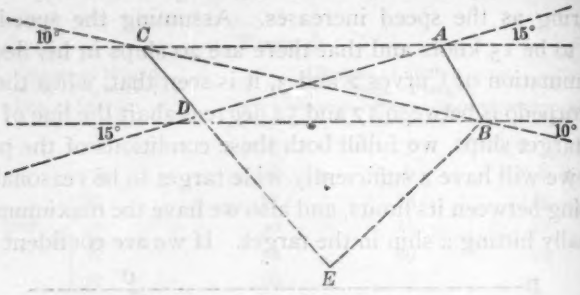


FIG. 9.

line of bearing when the firing ship is on the starboard side of the target ships, and from 10 forward to 15 abaft the line of bearing when on the port side. Now we will consider the target to be under way at a speed of 15 knots, and will calculate the chances of hitting for various courses of the torpedo. Four cases arise and will be taken in order.

CASE 1.

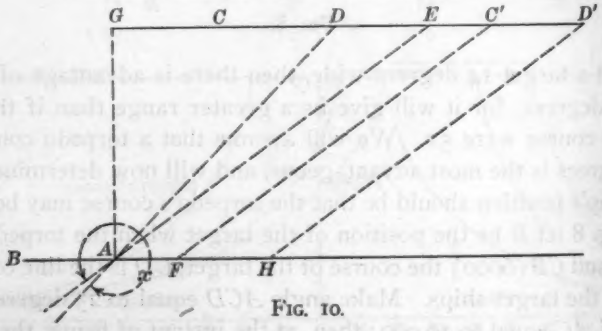


FIG. 10.

AE is the course of the torpedo. $AG=DG=350$.

(1) $AE=350\sec(x-45)$.
$EG=350\tan(x-45)$.
(2) $CC'=3/5\,AE$.
(3) $CG=200$.
(4) $CC'+200=C'G$.
(5) $EC'=C'G-EG$.

Lay off $AF=EC'$ and $FH=C'D'=150$.
Therefore a torpedo passing through AF will not hit.
A torpedo passing through FH will hit.
The chances of hitting are FH/AH.

CASE 2.

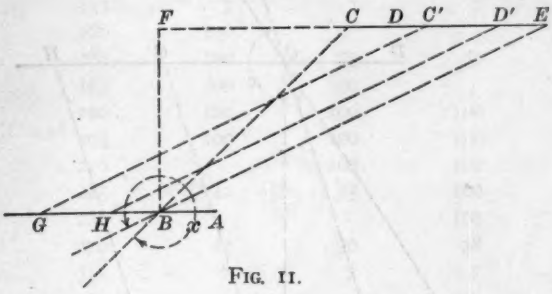


FIG. 11.

BE is the course of the torpedo and DD', FD', FE and $D'E$ are found as in Case 1. Lay off $HB=D'E$ and $GH=150$.

(1) A torpedo passing through BH will not hit.
A torpedo passing through GH will hit.

(2) Therefore the chances of hitting are GH/GB.

CASE 3.

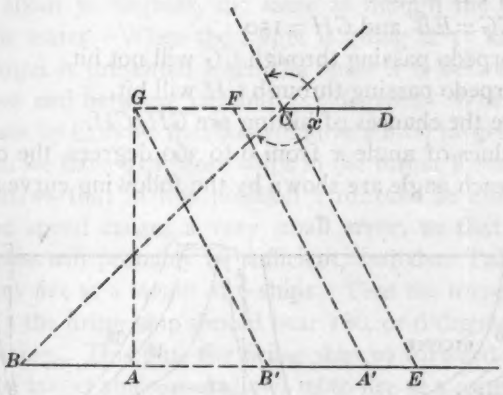


FIG. 12.

CE is the course of the torpedo and BE, CE, BA', and $A'E$ are found as in Case 1. Lay off $CF=AE$, and $GF=150$.

(1) A torpedo passing through CF will not hit.
A torpedo passing through GF will hit.
(2) Therefore the chances of hitting are FG/CG.

CASE 4.

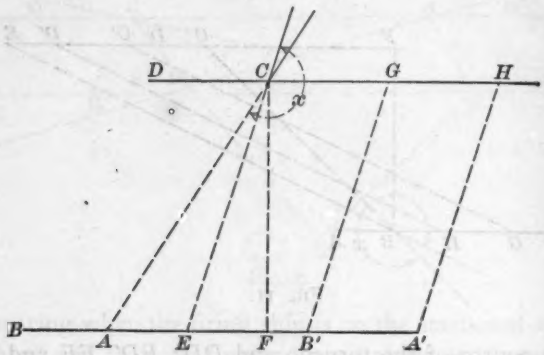


FIG. 13.

CE is the course of the torpedo, and EF, CE, AA', and AB' are found as before.

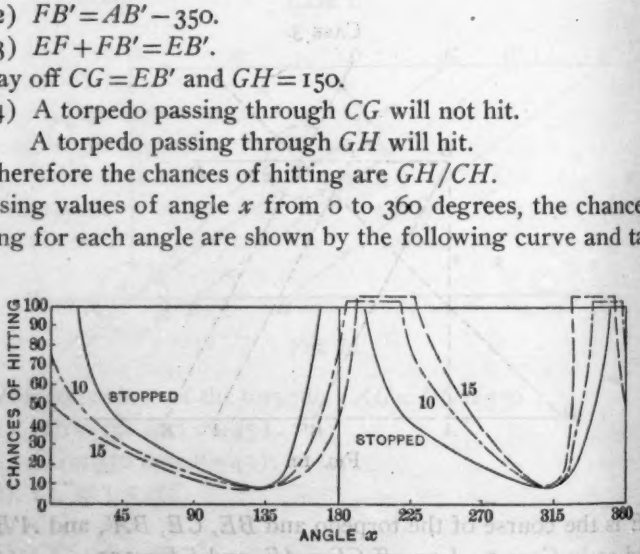
(1) $AF=350$.
(2) $FB'=AB'-350$.
(3) $EF+FB'=EB'$.

Lay off $CG=EB'$ and $GH=150$.

(4) A torpedo passing through CG will not hit.
A torpedo passing through GH will hit.

Therefore the chances of hitting are GH/CH.

Using values of angle x from 0 to 360 degrees, the chances of hitting for each angle are shown by the following curve and table:



CURVE 4.

TABLE 7.

Angle x.	Speeds of target.		
	Stopped.	10 knots.	15 knots.
0	100	75	50
15	100		
45	42	31	27
90	22	17	15
135	7	7	7
170	100		
180	100	75	50
183	100	100	
190	100	100	100
195	100	100	100
216		100	100
225	42	75	100
227			100
270	22	30	38
315	7	7	7
329			100
337		100	100
344		100	100
350	100	100	
355		100	
360	100	75	50

It will be noticed that for speeds of target of 10 or 15 knots the total sum of sectors through which a continuous target is presented is about 50 degrees, the same as though the target were dead in the water. When the target is going at 15 knots, a continuous target is presented when the angle x is between 190 and 227 degrees and between 329 and 344 degrees. When the angle is 215 we see by Curve 2 that we will have a total target 14 degrees wide, when we have 9 or more ships in the target formation. But Table 4 shows that in this position a mistake in estimating the course and speed causes a very small error, so that a target 7 degrees wide will probably be sufficient, and thus Table 5 shows that we may fire at a target of 6 ships. That the torpedo's course may be 215 the firing ship should bear 186, or 6 degrees abaft the line of bearing. This puts the firing ship 39 forward of the port beam of the target ships, and allows us to fire at a range of 12,500 yards. This position is the most advantageous one that could possibly be found.

When the torpedo's course is between 329 and 344, there is small chance of hitting. At 329 we are 76 degrees abaft the beam

of the target ships and cannot reach the target until the range is 4400 yards, while at 344 we are but 16 degrees from the line of bearing and have not a sufficiently wide target unless there are 20 ships in the target; and we are still 61 degrees abaft the beam and cannot fire at a range greater than 5000 yards. Thus it is seen that on the starboard side of the target ships, in this formation, there is little chance of hitting. We may state the general rule that, when the target is in line of bearing on the starboard quarter of the leading ship, it is necessary to fire at its port side, at a position 6 degrees abaft the line of bearing. When the target is in line of bearing on the port quarter of the leading ship, then the best position is on its starboard side about 6 degrees abaft the line of bearing of the target ships.

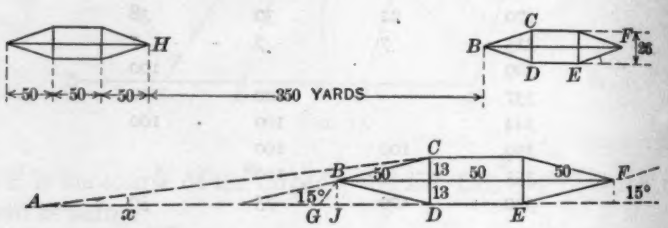


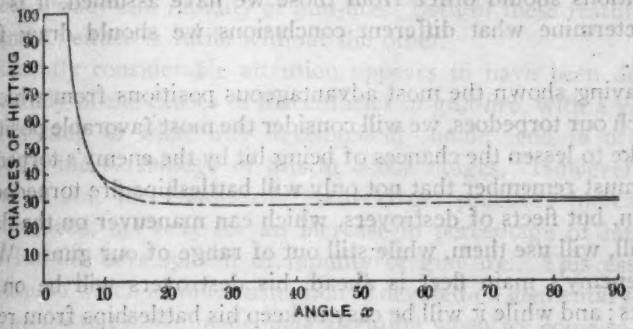
FIG. 14.

We will now consider the target ships in column, and the ships to be constructed as in Fig. 14. In this problem the speed of the target ships may be neglected. When the torpedo's course is within the sector from dead ahead to 15 degrees on the bow, the chances of hitting, considering the distance from the stern of one ship to that of the next ship in column, are: $AD+DE/HF=AD+50/500$. When the course of the torpedo is greater than 15 degrees, then the chances of hitting are: $GJ+JD+DE+EF/500=GJ+150/500$. Another thing that must be considered is the fact that, when the torpedo is coming from nearly dead ahead of a ship, it may be slightly deflected from its course by the bow wave, and miss the ship. Also when it strikes a ship at a small angle, the torpedo war-nose may not function. These problems should be solved by experiment. To cover this case we will put a second column in Table 8, calculated on the assumption that a torpedo must hit the ship's side at an angle of at least 5 degrees to be effective.

TABLE 8.

Angle between the torpedo's course and target's course.	Chances of hitting.	Same with effective angle of 5°.
2	100	100
5	70	70
8	47	47
12	35	32
15	39	32
20	37	37
25	36	36
30	34	34
45	33	33
90	30	30

From the curve it is seen that, in order to have any decided advantage in the chances of hitting, we must fire so that the course



CURVE 5.

of the torpedo is from nearly ahead. If we do not fire from this position, it is of no more advantage to fire from a position 15 degrees on the bow than from abeam, except that it allows us to fire at a greater range. Firing from a position about 3 degrees on the bow has many advantages, even though it presents but a small target, 3 degrees for 20 ships in the target. This small target is sufficient, for the following reasons: First, there will be no error made as to the enemy's course. Second, his speed has no effect on the problem, except to allow us to fire at a range of 16,000 yards, or if we wish to fire at 10,000 yards, then the time the torpedo takes to reach the target is greatly decreased, and this is of great advantage, when we consider that the target may change course or speed at any instant and thus make all our torpedoes miss.

We may sum up our conclusions as follows:

(1) When the enemy is in column, we should fire from a position 3 degrees on the bow of the target.

(2) When the enemy is in line, we should fire from a position 11 degrees ahead of his line of bearing.

(3) When the enemy is in 45-degree line of bearing, we should fire from a position 6 degrees abaft the line of bearing, on his port side if the line of bearing is on the starboard quarter of his leading ship, otherwise on his starboard side. For a six-point line of bearing we should fire from a position between that for line and that for 45-degree line of bearing; and for a two-point line of bearing, from a position between that for column and that for 45-degree line of bearing. These conclusions, it is true, hold good only for what we have assumed to be average conditions, but if the actual conditions should differ from those we have assumed, it is easy to determine what different conclusions we should draw from them.

Having shown the most advantageous positions from which to launch our torpedoes, we will consider the most favorable positions to take to lessen the chances of being hit by the enemy's torpedoes. We must remember that not only will battleships fire torpedoes in action, but fleets of destroyers, which can maneuver on the flanks at will, will use them, while still out of range of our guns. While the enemy's main fleet is ahead, his destroyers will be on our flanks; and while it will be easy to keep his battleships from reaching a favorable position, we cannot, in addition, maneuver to keep the destroyers from taking these positions. On the whole, column is the safest formation, for it will be fairly difficult to gain and keep a position ahead of it. Line is very dangerous, as it presents a continuous target through such large sectors. Line of bearing on one side would be absolutely fatal; but if we could be sure that the enemy's ships could not reach this side, then the other side would be the safest of any formation we could take.

I have tried to give an idea of the best way to use torpedoes in action and the best positions to take to avoid those of the enemy; but, while I believe the groundwork to be correct, I realize that others might draw different conclusions. My main object is to bring to the attention of the fleets this very important subject, which, I believe, has never been considered by a large majority of their officers.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

RAPIDITY OF GUN-FIRE.

By LIEUTENANT C. C. GILL, U. S. Navy.

Excellence in gunnery is measured by hits per gun per minute; therefore, the primary end of gunnery training is the attainment of both accuracy and rapidity of gun-fire. Both of these features are essential; either is futile without the other.

Recently considerable attention appears to have been devoted to a study of the causes of inaccuracies in gun-fire, with a view of determining in what way development should tend in order to increase the *percentage* of hits at battle ranges. However, it is believed that the results of recent target practices indicate an urgent need, not only for an increase in percentage of hits, but also for the development of rapidity of gun-fire. This essential feature, to which so much attention is devoted on elementary practice, seems to receive inadequate attention when we come to long-range battle practice.

In view of the consideration that rapidity would avail nothing without accuracy, and further in view of the consideration that rapidity has an effect upon accuracy, it would seem necessary, before entering upon a discussion of rapidity of gun-fire, to arrive at some kind of an understanding regarding accuracy of gun-fire. Therefore, with this end in view, it will be attempted to summarize briefly the conclusions which logically follow from the arguments contained in the discussions of "Dispersion and Accuracy of Gun-Fire" published in the PROCEEDINGS and written by Admiral Fiske, Captain Glennon, Lieut.-Commander McLean, Lieut.-Commander Craven, Lieut.-Commander Knox, Lieutenant Long, Lieutenant Van Auken, Lieutenant Schuyler and Ensign Elliott.

Upon reading Lieutenant Long's discussion, the question which first suggests itself is whether speculation of this sort is more likely to lead people right than to lead them wrong. But it seems

reasonable to believe that benefit rather than harm will result, because, without reference to the soundness or unsoundness of the propositions set forth, speculation along such lines promotes investigation of important professional subjects and if, in the course of investigation, questionable matter is introduced, general discussion can be relied upon to safeguard the service from the practical applications of dangerous inferences.

ACCURACY OF GUN-FIRE.

It has been pointed out by Lieutenant Long that:

> In any analysis of gun-fire it is evident that the hitting of a target depends on two factors:
>
> (a) Range error and lateral error.
>
> (b) Dispersion, both vertically and laterally.
>
> For convenience these may be referred to as fire-control errors and dispersion errors.

These two kinds of errors are the result of divers causes interrelated in such an intricate manner that any attempt at dialytic discussion is extremely confusing. But, for the purpose of this paper, it would appear that the relation between the ability of the fire-control and the dispersion of the salvo can be satisfactorily expressed by a convenient simile, in which the ability of the fire-control is compared to the skill of a huntsman, and the dispersion of the salvo to the dispersion of the charge from the huntsman's weapon. This simile will be used to illustrate the three general conditions: (a) indifferent; (b) good; (c) perfect.

(a) To illustrate the condition "indifferent" we may liken the fire-control of inferior ability, directing widely dispersed salvos, to an unskilled huntsman handicapped by defective eyesight and unsteady nerves, who is supplied with a shotgun having a large dispersion, in order that some scattering shot may be tolerably sure, sooner or later, of bringing down an unlucky bird.

NOTE.—It is evident that the larger the dispersion the larger will be the danger area; but it is also evident that the larger the danger area the less effectively will this area be covered, and while, under this condition a poorly aimed shot may occasionally kill a bird, on the other hand, no matter how accurately the gun is aimed, a large percentage of misses is to be expected.

(b) In like manner, to illustrate the "good" condition (*i. e.*, whereby a fire-control of good ability directs salvos with com-

paratively small dispersion) there is the analogy to the huntsman of average skill supplied with a shotgun with comparatively small dispersion, by which a large percentage of hits is assured because the danger area, though limited, is effective.

NOTE.—It is evident that a skilled huntsman using this close-shooting shotgun will be more successful than a huntsman using a scattering shotgun, whether he be skilled or unskilled, because the scattering shotgun absolutely prohibits a large percentage of hits.

(c) Lastly, to illustrate the "perfect" condition (*i. e.*, whereby a perfect fire-control directs salvos with *nil* dispersion) consider a huntsman of infallible skill, supplied with his proper weapon, evidently a rifle. (The hero of the "Leather Stocking Tales," who could direct a single bullet with such unerring aim as to cause it to pass through the bodies of two distant birds as they crossed in flight, would probably have scorned the use of any shotgun.)

NOTE.—It would, however, be extravagant to the highest degree to suppose that this ideal condition of a perfect fire-control and *nil* dispersion will ever be attained in practical gunnery.

It seems unfortunate that the data compiled by Lieutenant Long from results of target practice should indicate that the ability of our fire-control is on a par with the skill of the huntsman handicapped with the defective eyesight and unsteady nerves.

NOTE.—In order to prevent a wrong inference from the analogy, it is desired to point out that the term "ability of fire-control" as here used includes considerations of matériel as well as considerations of personnel.

However, it seems to be the consensus of opinion that this uncomplimentary comparison will not long be justified, and that the way practically to improve our gunnery is not to increase, but to decrease, dispersion of all kinds, and at the same time to exert the utmost endeavor to reduce the fire-control errors. Therefore, this opinion will be accepted in so far as accuracy of gun-fire bears upon this discussion of rapidity of gun-fire.

NOTE.—If in the future the dispersion should be reduced to *nil* by some miraculous invention, then, unless by another miraculous invention the ability of the fire-control is made perfect, it might be desirable to produce a pre-determined uniform dispersion in some such way as by sending different ranges and deflections from the substations to the various guns. In the meantime, the theories based on an assumed uniform dispersion, when in reality a haphazard dispersion exists, should be received with qualification.

RAPIDITY OF GUN-FIRE.

The formula "hits per gun per minute," by which gunnery efficiency is generally measured, clearly indicates that the factor rapidity is of well recognized importance. But "rapidity" is an abstract word capable of various interpretations, and officers who are perfectly agreed as to the importance of rapidity often disagree hopelessly respecting the question of what *degree* of rapidity is practicable and desirable in actual long-range fire. The reason for this is probably the diversity of opinion which exists as to the effect which rapidity of fire has upon accuracy, safety, and reliability.

Some officers are of the opinion that it would never be desirable to have the interval between salvos less than the time of flight plus the time required to apply a spotting correction. The reason for this opinion is evidently to be found in the assumption that it is necessary to afford an opportunity for applying a spotting correction after each salvo. It is admitted that this interval between salvos is desirable as long as the salvos are not hitting; but as soon as the correct sight-bar range has been determined it would seem highly desirable to get in as many salvos as possible, in the least possible time, and in accomplishing this end it would appear an advantage rather than a disadvantage to be able to keep two salvos in the air at the same time. If the range is extreme, if there is a shortage in ammunition, if the salvos are not hitting, if, when two or more ships concentrate their fire, it is desirable to follow a prearranged scheme by which spotters may identify the salvos from their respective ships, or if there is any reason for slowing down the firing, the fire-control officer can increase the interval between salvos at his discretion, because it is obvious that the ability to fire rapidly does not impose any obligation to do so, unless circumstances make it advisable. On the other hand, a crew trained so that they can fire a salvo every 20 seconds, would, if allowed to fire only every 30 seconds, almost feel that they were at "slow fire."

"Go slow but sure" is a dangerous maxim in gunnery—especially if the other fellow is going faster but equally as sure. It is therefore incumbent on those who advocate slow salvos to show that they can thereby derive more hits per minute. It is not believed, nor has it ever been shown, that rapidity of fire is incompatible with accuracy, and if it be true that rapidity and accuracy are not in-

compatible, then we must expect defeat if we ever fight a nation that has found out this truth, and that acts upon it. In order to show that rapidity is not necessarily incompatible with accuracy, safety and reliability, it appears that a useful argument may be found in the analogy between the quick thinking and quick acting required of a member of a gun's crew and the quick thinking and quick acting required of a baseball player. In both cases there are the excitement and nerve tension and intervals of inactivity, during which the mind is anxious and alert, followed by quick action requiring skill and precision. It will be admitted that the art of baseball has been thoroughly studied and exhaustively analyzed; therefore, if the analogy is well drawn, a useful lesson may be learned from the fact that, in the case of a ground-hit ball, regardless of how much time there may be in which to get the ball to first base before the runner, the infielder is coached *always* to get the ball as quickly as possible and throw it to first base as quickly and hard as possible. It has evidently been determined that there is less likelihood of the infielder making an error if he is taught to form the habit of making *all* plays at top speed. The inference is that under some circumstances it has been learned, by practical experience, that the application of the "go slow but sure" maxim does not necessarily favor precision.

In this connection it is instructive to note a change which was made a few years ago in the "Rules for Elementary Practice," by which the formula for measuring the efficiency of gun-pointers was modified. Before the change, the rules were so framed that pointers were rated in efficiency in accordance with the simple formula "hits per gun per minute," except that, in the case of a tie in the hits, the pointer who fired the most rapidly was rated the best pointer. After the change, the rules were so framed that, in the case of a tie in the hits per gun per minute, the pointer who fired the most rapidly, instead of being rated the best pointer, was heavily handicapped for each shot that missed the target, so that his final standing in efficiency as a gun-pointer was considerably below other men who made the same number of hits per gun per minute, but who fired more slowly and made fewer misses. The justice of this method of determining the final merit of pointers depends upon whether the slowness in firing is because of greater care and skill on the part of the pointers or whether it is due to

inefficient work on the part of the loading crews or to some other cause beyond the control of the pointers.

A comparison of the scores made in the target practices of the past six years indicates that satisfactory progress in the development of rapidity in hitting has not been made. How much the above-mentioned change in the rules has had to do with this unsatisfactory progress is difficult to determine; perhaps very little. Moreover, it is appreciated that at the time this change was adopted a drastic measure was required to force the pointers to take proper aim. However, it is believed that the need for this extreme measure no longer exists, and before putting permanently into practice a theory which tends to decrease the rapidity of our gun-fire, it seems no more than reasonable to require evidence that good, rather than harm, is likely to result. Therefore, it is suggested that it might now be advisable to try the middle course of measuring excellence in gunnery by the simple formula "hits per gun per minute," without either adding on or taking off a percentage for the shots that miss.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NECESSITY OF PROTECTING OUR ATHLETES.

By LIEUT. COMMANDER HARRIS LANING, U. S. Navy,
Recently in Charge of Athletics and Physical Training at the U. S. Naval Academy.

The sporting pages of many of the leading papers of the country have recently commented on an announcement from the U. S. Naval Academy that midshipmen would not hereafter be allowed to participate in rowing races of a greater distance than 1 5/16 miles, or in individual running races of greater distances than one-fourth of a mile. The reasons for the adoption of these rules were not published, and, though the Naval Academy authorities believe that their stand is absolutely necessary for the well-being of the midshipmen, the action has met with some criticism in the press. This article will explain why the step was taken at the Naval Academy and it is hoped that other institutions, after learning the reasons, will consider the advisability of taking a similar stand, or, before continuing the present policy, will at least satisfy themselves that by so doing they are *properly* caring for the best interests of their undergraduates.

It must be understood that the Naval Academy authorities took the step with reluctance and only after long consideration; for crew racing in particular had been highly developed at the Naval Academy, and the long success in that branch was a matter of pride throughout the navy. It was led up to by a study of the existing physical condition of the officers of the navy made by the surgeon general. In the navy every officer is required to take a physical test, a ten-mile walk once each month. Just before and just after the test taken in January of each year, each officer is given a rigid physical examination and a record is made of any defects found. In addition to this annual physical examination, each officer must pass another physical examination each time he

is promoted. It will, therefore, be seen that the physical condition of the officers of the navy is closely watched and that, as a class, naval officers offer an exceptional opportunity for the study of the effects of athletics and other forms of physical training. This is especially true since before being accepted as a midshipman each candidate must pass a very thorough physical examination, and if found defective is at once rejected. Those who enter the Academy are therefore practically without a blemish physically.

Knowing that the young men who have received commissions in the service were physically sound on entering, the surgeon general, in his study of their present condition, became impressed with two facts:

First, the great increase in recent years in the number of young officers who were lost to the service, by death or retirement due to physical disability, especially among those who had been athletes, and

Second, the great number of young officers who, though they had been athletes at the Naval Academy, had, in a few years after graduation, developed physical defects.

The surgeon general's study of the subject was thorough. He went over the records of all the officers of the navy of the classes from 1891 to 1911. Not counting those who have been lost to the service by accident or by diseases not pertinent to the subject, he found that in these classes there were 625 who had records as athletes. There were undoubtedly many others who had been athletes, but there were only 625 who had left a record. Of these 625 he found that nine were dead and 12 had been retired from causes that may have been the direct or the indirect result of too strenuous athletics. Of these 21 athletes who have been completely lost to the service, six were lost from tuberculosis, eight from mental or nervous diseases (three suicides on account of ill health), two indirectly to alcoholism, one death each from acute dilation of the heart and valvular disease of the heart (both directly attributable to track and crew racing) and one from an injury received in a football game.

Of the remaining 604 still in the service, 198 were found to have disabilities or abnormal conditions of sufficient moment to be incorporated in their official record, *and to which their records as athletes bear a possible or causative relation.* While in most instances these defects are not such as to incapacitate the individual

at the present time, they nevertheless tend toward an imminent or premature loss of service. Of the 198, 48 have defects referable to the heart or blood vessels, such as arteriosclerosis, organic heart disease, heart murmurs, irregular or rapid heart action and hypertrophied or dilated heart. The joints or motory apparatus are involved in 16 cases, and the kidneys in 11. Seventeen are either frankly tuberculous or have symptoms indicative of tuberculosis. Neurasthenia, associated with dyspepsia in several instances, occurs in 16 cases. Twenty-five cases of appendicitis and 15 cases of hernia were found, the latter being associated particularly with a football record. The remaining 50 had various defects any or all of which may be the result of too much athletics.

Having established the facts given above, the surgeon general made them known to the Secretary of the Navy by letter and invited the Secretary's attention to the subject of physical training and athletics at the U. S. Naval Academy, which he considers to be of vital importance to the naval service. In his letter, the surgeon general held that the primary object of all physical exercise at the Academy should be the development of the physique in a symmetrical manner and to such an extent as to conduce to the present and *future* physical and mental well-being of the individual under the varying vicissitudes of the naval service, and that to this end exercise should be pleasurable, adapted to the physiological age, equable and fairly continuous. The overdeveloped athlete of huge musculature and hypertrophied heart, or the highly specialized athlete is not desired, as he is less liable to withstand successfully the comparative inactivity of ship life than the man of average physique. Since life on board ship is from a physical standpoint bound to be comparatively inactive, the surgeon general held that the training for it should not be too severe and, while holding that physical training without competition is drudgery, he believed that competition without restraint would result in harm to the individual as well as to the government.

The Secretary of the Navy forwarded the surgeon general's letter to the superintendent of the Naval Academy, who appointed a board of seven officers to study the subject further. With one exception the seven members of the board were not athletes. Two of the members were medical officers, one of whom had made a special study of physical development. Without exception the members of the board were believers in athletics and had faith in

the beneficial results of athletic sports, but they all had the good of the service at heart and were determined to use their utmost endeavor to come to the right conclusion.

The board did not take the surgeon general's statistics as being *conclusive* proof of the harmfulness of specialized athletics, though when a total of 219 out of 625 athletes develop physical defects shortly after starting their athletic career the proof seems positive. At that time the board had no statistics on the officers who had not been athletes and they felt that without such statistics the proof of the harmfulness of athletics was not complete. Still, the statistics supplied were sufficiently startling to make any investigator believe that there must be some connection between an overindulgence in athletics and a quick development of physical defects, and the board felt that it was incumbent on them to make a thorough study of the subject and prove whether or not there is such a connection. A complete investigation of physical training and athletics at the Naval Academy was then made.

The board found that the midshipmen get their physical exercise in two ways: the first compulsory through physical drills; the second voluntary through athletics. The compulsory physical drills form a progressive course in physical training, covering the four years a midshipmen spends at the Academy. The system appears to be excellent. Under it each midshipman, immediately after entering the Academy and again during the first month of each school year, is given a dynamometer strength test. In this test the strength of practically every working muscle of the body is measured separately. A standard of strength, in accordance with the height of the individual, is established for each muscle. The standard increases with each year of the course, thus insuring a progressive development. The results of the strength test of each midshipman are entered on his physical chart, on which is also shown the standard adopted. These charts show at once in just what muscles the midshipman is undeveloped. By arranging the midshipmen in groups according to their weaknesses and giving each group suitable exercises, the normal for all muscles is gradually attained. Those midshipmen who are shown by the test to be up to the standard are given only enough compulsory exercise each year to bring them up to the standard of the next year, while those who are below the standard are given additional drills to eradicate their weaknesses. In this way all midshipmen are gradually

brought up to the standard established and a class graduating from the Academy at this time shows a high average of strength uniformly distributed over the body. The board believes that the young men developed on this system are especially well fitted for the navy from a purely physical point of view.

Though the system of physical training described above meets every requirement of the naval service, the board was of the opinion that it lacks some features that are essential to the young man's well-being. It is all work and no play and does not offer the mental relaxation that every student must occasionally have. Midshipmen have very little recreation time and during that time mental relaxation is essential. Properly played athletic games bring this relaxation, take the young man out of doors and bring him into closer relations with his fellow students. Athletic games also have the advantage of making a young man resourceful, quick to think and act, and self-reliant—qualities essential to a naval officer and which cannot be developed by routine physical drills. And last, but not least, games, even when not participated in, attract the students as spectators, take them out of doors and furnish wholesome amusement at times that might otherwise be spent in a much more harmful way. The board, therefore, felt that there is every reason to encourage the voluntary participation of midshipmen in athletic games, provided such games do no harm to the individuals playing them.

To determine whether or not the athletic games were harmful necessitated a study of each of the games played by midshipmen. It was found that midshipmen have contests with outside teams in football, basketball, fencing, wrestling, swimming, gymnastics, rifle shooting, lacrosse, lawn tennis, baseball, crew racing and track. While in all the sports named there are either inter-class or inter-company contests, the board found that such contests were not severe and that the training for them is so light that these games within the Academy are not harmful in any way. But the Academy teams that compete with outside teams are highly trained and highly developed and if any harm does result from athletics it would come to the individuals on these teams. Each of the above sports was therefore investigated along two lines—the first to learn if the sport gave an undue chance of injury by accident or otherwise, the second to learn if the sport was apt to produce overstrains that might in the future develop into physical defects.

In the first of these investigations we found the results favorable to all sports except football. To football was accredited nearly all the serious bodily injuries found among our students, and in past years these injuries had been both numerous and severe. But during the past three years, since the adoption of the new rules, serious injuries in football had been very rare at the Naval Academy and the board therefore decided that football had so many advantages as a game as to more than offset the now fairly remote chance of a serious injury and therefore voted that football should be retained.

In the second line of investigation it appeared to the board that overstrain of the muscles or organs to which premature breakdown might be attributed is to be found only in those sports where there is tremendous and continuous exertion and where *endurance* is the essential feature. In all the sports except swimming, crew racing and distance running, it was found that the periods of great exertion are short and are immediately followed by periods of comparative inaction during which nearly normal conditions are restored. The board therefore felt that there could be no harm in those sports. As only very short swimming races are indulged in by the midshipmen the board held that no harm could come from that sport and it was given a clean bill. This left only crew racing and distance running to be considered and in each of these it was found that not only is there terrific exertion, but the strain is continuous for a comparatively long period. In the two-mile races, which had always been the standard distance for our "first" crew, the excessive strain lasts from ten to eleven minutes, while in running races it lasts various times up to ten minutes, the time for a two-mile race. It was shown that in both crew races and distance running there were frequent cases of collapse among the participants at the end of the race. Complete exhaustion, accompanied by nausea and fainting, were very common in distance running, showing beyond a doubt that the individual had *far* exceeded the limit of his endurance.

Medical opinions given to the board showed that during both crew and running races the heart is called on to do an abnormal amount of work and is thus overloaded and dilated as are the arteries. Extreme effort of this kind is not dangerous except when frequently repeated, but when frequently repeated the heart and arteries gradually take on a permanent "set" or "dilation" and

never again go back to normal. As the training for a crew man or distance runner is as much or more of a strain than the actual races, it can be seen that in these sports there must be grave danger to the participants. Distance running being the worse of the two evils and being a sport of lesser importance at the Academy was at once unanimously condemned and the board recommended that no running races of over one-fourth of a mile be allowed.

In the case of rowing the results were almost as serious and were sufficient to condemn it as a sport, but before doing so the board wanted even more statistics and began to look them up. Further statistics were found, some for and some against the sport, and these statistics were a puzzle, for while some seemed to prove *conclusively* that long crew races are in the end beneficial, others proved even *more conclusively* that they were harmful. The board considered these statistics from every angle and finally came to the conclusion that the statistics against long rowing races were the more trustworthy and convincing. Not that the favorable statistics were false, for as far as they went they were accurate. The trouble was that they did not go far enough. In most cases the men under consideration gave *their own* opinion of their physical condition and though many of them may have the defects our athletes have they would be evident only to a medical man who had made a rigid examination. In this instance personal opinion is not good enough evidence of the true condition and many of the men had not been examined in years. But a still weaker spot in these statistics was the fact that they dealt only with the men who had actually made the varsity crew and the "near" varsity men were not considered. Only the very hardiest and strongest were taken into consideration and these were the men who could best stand the strain. There was no record at all of those who had tried and failed, who gave their best only to fail, and who, having failed, passed out of the counting.

Information, asked for and received from the medical officers concerning the effects of overtraining the muscles and overstraining the organs, all indicates that the effects are bad, *especially to those who follow the sea for their life's work.* In civil life the highly developed athletes with their convenient athletic clubs and gymnasiums and facilities for taking exercises such as tennis, rowing, golf, riding, walking, etc., may easily keep up partial training and so retain their splendid physique, but to the man on the

sea these things are not available. In the drills and routine work of an officer on board ship there is but little that savors of good healthy exercise and when the day's work is done the recreation hours are spent in cramped quarters below deck where there is no opportunity for physical exercise. To the highly developed athlete a complete let down from training is harmful, for the muscles deteriorate and become fatty when not used. A less highly developed man suffers but little. For the highly developed athlete there is a still worse feature in that his muscles, which require stimulating exercise and get none, set up in him a desire for stimulation of another kind which seeks to satisfy itself in overeating, in the use of alcohol, in seeking exciting amusements, etc., all of which have bad effects. While the athletes in civil life *may* avoid these consequences by keeping up their exercises, there is for those in the navy a strong tendency to deteriorate rapidly, and in view of this condition was it not the board's duty to condemn sports that produce such conditions?

To completely eliminate crew racing at the Naval Academy would be a radical step inasmuch as there is a strong feeling throughout the country that sea-going men should excel on the water. This view was taken by those high in authority at the Academy and in the navy, and the board itself, in spite of the damaging evidence against crew racing, was loath to recommend its complete abolishment. The board then set about finding if there could not be some way of ameliorating the conditions so that the sport could be retained, at least until it could be proven that rowing races are *always* harmful. The only solution seemed to be to make the race shorter and to cut out the one objectionable feature—endurance.

A study was then made of the length of college boat races and it was found that there are two distances in general use—four miles and two miles. Most of the great varsity races are for four miles and require from 20 to 22 minutes to pull. The preliminary races and the races of lesser importance are usually for two miles. As both of these distances are objectionable, some other distance was looked for. One other well known distance, 1 5/16 miles, known as the "Henley" distance, was suggested and was investigated. It was found that for the great boat club races in England this is the distance used and has more recently been taken as the distance for the races of the American Rowing

Association, held annually in Philadelphia and known as the "American Henley." As the time to cover this distance is about two-thirds the time required for a two-mile race, a reduction in time of about four minutes, and as the medical officers were of the opinion that the wear and tear in the human body would be reduced in a very much greater proportion if the distance were adopted, the board decided to recommend this distance if it could be shown that it would make a good race and would really test the rowing ability of the various crews. We found that the original reason for adopting the distance was that a longer course was not available, but that having been adopted it had proved especially satisfactory to boat clubs and others who go into crew racing for its beneficial exercise. We found also that at the American Henley college crews were rowing that distance and found it to their liking. It appeared to the board to offer the special advantage of cutting down the long strain while at the same time it puts the great premium in boat racing on skill and watermanship instead of on brute strength and endurance as do the longer races. It is a perfect test of ability and strength with most of the harmful features eliminated.

That the stand taken was a wise one has been proved by subsequent statistics submitted by the surgeon general who has since made a study of the medical records of 580 non-athletes of the same classes at the Naval Academy as the athletes already considered. He found that in the *total number* of casualties and recorded defects there was no material difference in the two classes and this would make it appear that though generally stronger men at the start, the athletes have gained nothing by their work. On the other hand, in studying the diseases of each class he found that whereas only one man among the non-athletes had died of these diseases attributed to over-indulgence in athletics, six athletes had died of these diseases—a remarkable coincidence even if not accepted as proof positive. In diseases attributed to athletics there was in every instance an excess of fifty per cent *or more* cases among the athletes than among the non-athletes.

So far as the Naval Academy is concerned, the subject ends here. But is the Naval Academy the only institution concerned? If long distance rowing and running races result in harm to our graduates, do they not result in harm also to the graduates of other institutions? The ill effects on those who go into civil life

may as a rule be a little less marked, but even then are the authorities of other institutions sure that in allowing these sports they are not actually doing harm to the young men sent to them for mental and physical improvement? If rowing is to be retained at these institutions it seems to us that common sense calls for a shortening of the races and if the races can be shortened and be kept as good as they are now if not actually made better, then why not shorten them? And if any one thinks the 1 5/16 miles race is not a good race let him journey to Philadelphia and see the races at the American Henley. If he has not seen them and is really interested in crew racing he will be most agreeably surprised. And to those institutions that have already studied this problem, we say study it over again using the figures given herein, and after thinking and studying they should publish their honest findings. If we are *right* we want them to know it and if we are *wrong we* want to know it. In the meantime we are at least protecting our young men from dangers they know nothing about. The question is "Are other institutions equally careful?"

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SCIENTIFIC SHIP DESIGNING.

By REAR ADMIRAL CASPAR F. GOODRICH, U. S. Navy.

This article has but one object in view—to call the attention of my colleagues to a book recently published, which every naval officer interested in new designs should read, mark, learn and inwardly digest. For empiricism, snap judgment and fads, it seeks to substitute features or ideas which have stood the test of war. The author holds that what the shock of battle has shown to be good ought to be retained; what that shock has shown to be valueless ought to be rejected, whether it be the material of which ships are constructed, the battery, armor, mode of propulsion, or special weapons. And the same scrutiny is applied to the tactical notions of which the ship herself is the embodiment.

If we cast our own eyes back upon the history of our new navy, we are struck by the great number of types which came into being as representing the current vogue only to fall into disfavor in the end. Such were the *Katahdin*, the *Minneapolis*, the armored cruisers—to mention but a few. In no instance was any new type rigorously tested, before adoption, for its harmony with the teachings of history. Generally speaking we saw what others were doing and tried to "go them one better." If we adhere to this practice we shall sin knowingly, since Sir Reginald Custance, R. N., has opened our eyes in his "Ship of the Line in Battle."

This work, by a most thoughtful and competent student of professional matters, a reprint of papers read at the Royal Naval College was called into being because of "the inconclusive character of the arguments usually advanced for and against different designs for ships of the line and by the total absence of any accepted principles to govern the nature of the armament, the amount of protection and the speed." It is not a history of armored ships but a careful analysis of actions between them and between ships and fortifications made from the standpoint of strategy as well as

of tactics, with a view to determining that relation between the military qualities of the fighting ship which is justified by history. There is nothing in his pages of the *à priori* methods which have governed naval architects the world over and to which are due the many mistakes that, too late, we all have to admit. Is the ram a good weapon? This question he answers by an appeal to fact and not to theory. Similarly he answers other questions as to the value of the gun, the torpedo and armor. He is never dogmatic; indeed it is more from inference than bold statement that his views are to be gathered. He relies, for the effect on his readers, upon a clear presentation of what has actually happened rather than upon argument. The most he allows himself in expression is a series of queries supplemented occasionally by modest suggestions. His manner is severely self-restrained—for he trusts his audience to perceive for themselves the fundamental truths which emerge from his judicial array of the details of the various engagements he discusses. Those who differ with him in the conclusions drawn must detect and point out the flaws in his contentions, must make good their position not by summarily dismissing him and them, but by a criticism as faithful and painstaking as his own.

Adequately to review a volume of this character would require vastly more space than is permissible. I shall content myself with indicating the theorems he lays down and the problems he proposes. I invite all interested in this vital matter to read his words for themselves.

> In a sea-fight the object is, at all ranges and in a given time, to strike blows greater in number than those received.
>
> Each blow must be effective, but not unnecessarily powerful, since the use of a gun heavier than is necessary means a reduction in the number of guns carried and, therefore, in the number of blows struck.
>
> The armament of each ship should be sufficient, but not more than sufficient, to do the work, as otherwise power would be wasted, and her destruction would involve the loss of an excessive proportion of the total fleet. . . . .

The above are the main theses he undertakes to prove—not by abstract reasoning, but by appeal to what has actually happened. It is with something of a shock that we see him led into condemnation of the all-big-gun ship which has met with such general acceptance. At last and after many trials and failures, we ex-

perienced the satisfaction which accompanies a definite solution of a serious technical question and the adoption of an axiom in ship design—only to find that the axiom is challenged and disputed by one who speaks not lightly and whose opinions are based on numberless experiments in the laboratory of naval warfare. May we not, he suggests, be hasty in rejecting the composite armament characteristic of the fighting ship which was developed through a century of naval warfare?

> The introduction of the carronade was a great and far-reaching departure in principle. The necessity for two distinct natures of guns on board a ship was recognized—a primary armament of long-range guns for distant firing, a secondary armament of short-range guns to increase the effect producible by a given weight of armament at "decisive ranges." Was the principle sound? . . . . "Decisive range" may be defined as that at which the one combatant develops such a superiority of attack that the other ceases to be able to offer further effective opposition. . . . . It is not sound to accept an advantage at one range at the expense of a disadvantage at another. If the armaments are equal in weight, but are unlike, and each composed of guns of one nature, in the one case of guns more effective at long range, in the other of guns more effective at short range, the first ship will have an advantage at long distances and the second at short. Neither armament can be considered ideal. Evidently an armament composed of guns of both natures is the only arrangement which gives no disadvantage to the user at any range. . . .

Again and again he reiterates the doctrine of Farragut that the best defence is a rapid and well-aimed fire. At Sinope, at Kinburn, in the *Kearsarge-Alabama* fight, victory was won by closing in to *decisive* ranges and smothering the enemy by effective use of the gun. At Lissa, it was the inefficiency of the Italian admiral rather than the ram which decided the issue, yet the naval world saw only the value of a new weapon and went mad for a time. Let me quote our author's words on the necessity of careful study of past wars on the part of a commander-in-chief.

> A man who has not pondered over the acts of the great leaders in wars of the past almost inevitably assumes the mental attitude of the bad workman who complains of his tools. He naturally asks for better ships and weapons, and relies on large ships, on thick armor, and on big guns. All these Persano had in preponderance on the day of battle, but they did not save him from defeat. The only safe check on such peace pedantry as his is to examine past war practice. It is only by study and reflection that an officer can come to know that victory does not depend mainly on such things, but on the courage, the will, and the intellect of the admiral, and on the spirit with which he inspires the officers and men of the fleet.

Speaking of the battle of the Yalu in 1894, Sir Reginald writes:

On the part of the Japanese, with whom rested the command of speed and partial control of the range, the failure was due to fighting at long variable distances—a condition unfavorable to hitting and entailing great waste of ammunition. Admiral Ito forgot the teaching of Farragut, who at Mobile Bay showed that unarmored ships must press in to close ranges to make their fire effective against armored ships. Unlike the American admiral, the Japanese showed no determination to defeat the two Chinese ships at all costs. The root idea of his tactics was not to disarm the enemy, but to avoid being hit—not victory, but safety. He forgot that high speed and a rapidly changing range made ineffective his own fire as well as that of the enemy. The result was indecision. . . . .

At the Yalu, as in the actions between the *Alabama* and *Kearsarge*, the *Atlanta* and *Weehawken*, the Italians and Austrians at Lissa, and between the *Huascar* and *Almirante Cochrane*, the side which ultimately fared worst was the first to fire. To open fire at long range during the approach usually results in a waste of ammunition, shows want of confidence, and is a sign of military weakness. As a rule the winning side reserves its fire until decisive ranges are reached.

During the Russo-Japanese campaign ten years later it was shown in its first phases that

These early actions confirm previous war experience that:

1. The effective way to use the gun is to get on a course parallel to the enemy at a nearly constant range.
2. Unarmored ships are usually beaten before their floating power and stability are destroyed.
3. Superior gun-fire covers its possessor from serious loss.
4. Men will stand up to their guns without armor protection.

. . . . The Japanese, by laying mines and impeding the exit of the Russians, had deprived themselves of the opportunity to win victory. . . . . The failure of the Whitehead torpedo was complete. Was this due to inefficiency in the weapon, or to an improper method of using it? To what was the failure of the gun due? Was the gun improperly used? May it be that attacks at high speeds on opposite courses, or underhelm, do not give proper opportunities either to the torpedo or to the gun?

As to the sortie of August 10, 1904, he says:

An admiral bent on fighting at a decisive range will try to reach it as quickly as possible. The manner in which he will approach and the range at which he will turn up are nice questions, only to be decided at the time according to the conditions, of which the chief is the distance at which the enemy may be expected to hit so often that his fire must be beaten down. Togo did not make use of his opportunity in the forenoon, and, as Vitgeft was bent on running away and not fighting, was never able to reach the decisive range at which his superior gun-fire would have enabled him to beat down quickly that of the enemy. . . . . There would have been

a better chance of hitting if each ship "had taken her own bird" and kept to it, since there is a falling off in accuracy when more than two ships fire at the same enemy, and the ranges of the various enemy ships differ little when two small squadrons are in parallel lines at such long distances apart. Again, under such conditions, no enemy should be left unfired on. It is not yet known on what enemy ships the Russians directed their fire. . . . . The great tactical lessons are:

1. That crossing the T is not necessarily always effective, since the enemy's movements are not controlled by doing so, and the conditions are not usually favorable to hitting.
2. The mistake of wasting time at "long bowls."
3. The risk from chance hits during a prolonged action at long range.

The wiser course now, as in the past, is to close in to decisive ranges, at which the enemy's movements can be controlled and his fire dominated, and to remain there, keeping him under the fire of your own guns until he surrenders or is destroyed. "No officer can do very wrong who keeps his guns bearing on the enemy." Togo had an opportunity to do this when the fleets first met, but did not seize it, and not only risked defeat, but failed to destroy the Russians after defeating them. The ships that escaped and returned to Port Arthur landed guns, ammunition, and upwards of 2000 men, who materially strengthened its defences. The results were that 60,000 Japanese soldiers were disabled before that fortress, and the Japanese armies were weakened in the great land battles. At the battle of Tsu Shima in the following May, the admiral showed that the lesson had been taken to heart. . . . . One-half the hits caused no casualties, and of the remainder the average number due to each 12-inch or 10-inch was about the same as that due to each 6-inch. . . . .

I am in a position to state that Sir Reginald's analysis of the various engagements between the Russians and the Japanese is based upon the most exact information obtainable—information which is beyond question even if his conclusions are not accepted. At an interesting moment of the great action between Togo and Rozhestvenski, when the latter was heavily pounding the *Mikasa*, he put his helm the wrong way, threw his guns off the target and threw away his one chance of victory. Doubtless the feeling that he had to do something is responsible for the tactical error which ensured his defeat. But to return to our author.

. . . . The Whitehead torpedo failed during the period of the Japanese War under review. The candid mind can hardly resist the conclusion that in a ship of the line it was then of little value, and that in the destroyer and torpedo-boat its efficiency as a weapon was then over-rated. Was this failure due to its own inherent imperfections or to its being improperly used? Probably to both causes, but certainly not to any method or practice special to the Japanese, who made as good use of their weapons as would any other nation at that time.

* * * *

The smallest gun required to maintain the ascendancy over the armor must be carried in sufficient numbers, but should not these be supplemented by others of smaller size to increase the volume of fire and to provide a larger margin for misses and failures? Ascendancy over the armor means that victory can be won in spite of it, that is to say, by perforating it if spread out, and by overwhelming the ships and crew if concentrated.

The precise sizes of these two natures of guns can be settled without difficulty, if the principle is accepted that they should be the smallest which will do the work. . . . .

An old and well-proved principle underlies the facts laid before you in these and previous papers. That principle gave the English bowmen victory in the Middle Ages, governed Napoleon's use of artillery, and enabled Wellington's thin red line to defeat Napoleon's columns. The same principle made the three-decker of the past the most powerful instrument of war at sea. The principle is the development of fire effect to the fullest extent possible. The decline in the value of armor and its possible reduction, coupled with the increased range of modern guns, are the changed conditions which enable a return to be made to the old principle.

Sir Reginald is right, it is high time to revise our methods and to design ships which embody that well-balanced proportion between the important characteristics which history has always approved. If we have, like all the rest of mankind, gone astray, we shall have no excuse for continuing in error now that we have his analysis before us. The biggest, most heavily armed and armored vessel, undoubtedly the best in single-ship actions, may not be the best when fleets are engaged. Are guns unnecessarily large for the work they have to do? Should we return to the secondary battery? If so, what ought to be its caliber? Is our armor rightly disposed? Is too much displacement accorded it? To what extent may it profitably be reduced? Have we sacrificed too much to speed? To answer these questions, which naturally arise in our minds, we shall be immensely helped by a careful study of this notable book, which I have no hesitation in repeating that all naval officers should read attentively. And this recommendation applies in particular to those who are called upon to advise the Navy Department on the plans for future constructions. Granted, for the sake of argument, that Sir Reginald is all wrong, I can imagine no more beneficial activity, on the part of those who conscientiously hold views opposed to his, than a painstaking and thorough refutation of his plea for testing new ideas by the touchstone of history. Personally, I fear they will not find the task as easy as, at first, they may be disposed to believe.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TRINITROTOLUOL, OR TROTYL.[1]

TORPEDO-CHARGES PREPARED WITH THIS EXPLOSIVE.

By Lieut. Comdr. Guilherme Hoffman Filho, B. N.

(Translated by Commander A. B. Hoff, U. S. Navy, from the December number of *Revista Maritima Brazileira*, 1912.)

We have adopted this year, as the explosive for our torpedoes, trinitrotoluol, or TNT, in view of the enormous advantages that it offers in force, stability, etc., over guncotton. We have substituted, at the same time, for fulminate of mercury in the detonators a new explosive, hydronitride of lead.

TNT or Trotyl.

TNT is obtained by the nitration of toluene, much the same as nitroglycerine is obtained by the nitration of glycerine.

Toluene is a liquid substance, colorless, boiling at 110° C. and is obtained by the distillation of coal tar. It is the first homologue of benzene, which it much resembles. For this reason toluene is also called methyl benzene. It was discovered in 1838 by Pelletier and Walter. It is found also, in the literature of chemistry, under the name "toluol," for which reason trinitrotoluene is also called "trinitrotoluol."

There are three known derivatives of toluene:

1. Mononitrotoluene ..... $C_6H_2CH_3(NO_2)$.
2. Dinitrotoluene ..... $C_6H_3CH_4(NO_2)_2$.
3. Trinitrotoluene ..... $C_6H_2CH_3(NO_2)_3$.

It is to be noted that, during nitration, one or more atoms of hydrogen (H) are replaced by one or more radicals (NO_2).

Mononitrotoluene.—The mononitrotoluene is obtained industrially by treating toluene with a mixture of nitric acid at 40°

[1] Synonymous terms for this explosive are: Trinitrotoluene, trinitromethylbenzene, tolite, trilite, trinol, tritone and trotol (Weaver's *Military Explosives*).—R. E.

Baumé and sulphuric acid at 60° Baumé. The nitration takes place in cast-iron vessels, cylindrical in form, and furnished with rotating paddles to keep the mixture in constant motion. After three hours of this digesting, the mixture is precipitated in water. The precipitate is first washed with alkaline water, and then with pure water. This precipitate is mononitrotoluene.

Just as during the nitration of glycerine the temperature never should exceed 30° C., so also in the manufacture of mononitrotoluene it should not pass beyond 50° C. To avoid a rise of temperature, the nitration vessels should have interior coils with a circulation of a cooling medium or liquid.

Mononitrotoluene is a solid substance, melting at 51° C., and was discovered by Saint Claire Deville.

Mononitrotoluene is not employed as an explosive by itself, but only in some mixture, such as Sprengel's explosives, Favier's explosive, etc.

Dinitrotoluene.—This derivative of toluene is obtained by prolonging the action of the nitric acid on the toluene, or by treating mononitrotoluene with this acid. This last process is adopted in all explosive factories that have been visited.

Like the first derivative of toluene, this also is a solid substance, melting at 70° C., and is slightly soluble in hot water and alcohol.

The dinitrotoluene, also, is not employed by itself, but always in mixture. Triplastite is an explosive frequently used in mines. It is composed of dinitrotoluene and guncotton.

We have already had one opportunity of using this explosive (dinitrotoluene) in a progressive powder to augment the initial velocity of a projectile, and with very good success.

Trinitrotoluene.—Trinitrotoluene, finally, is obtained by the reaction of the mixed nitric and sulphuric acids upon hot dinitrotoluene. In actual practice it cannot be obtained directly by the action of acids on toluene, although so stated in some works on military chemistry.

Trinitrotoluene is *the* explosive *par excellence*, having been adopted by the majority of countries as the explosive charge in grenades, as well as in mines and torpedoes.

The first practical knowledge of this compound comes from Germany, where it is better known under the name of *Trotyl*. This abbreviation is the one adopted by our naval commission in Europe, and is the one which we will use henceforth.

Its first application as artillery ammunition dates from 1902. Just as picric powders were given different names, so also trotyl has different designations.

Germany, in its military instructions, calls it trotyl; England, which adopted it in 1911, calls it TNT (trinitrotoluene); Spain, trytil; while others, as France, Italy, Turkey, etc., hold to the name trinitrotoluene.

GENERAL PROPERTIES OF TROTYL, AND ITS ADVANTAGES OVER GUNCOTTON AS A TORPEDO-CHARGE.

Trotyl is a definite chemical substance, crystalline, of a light yellow color which afterwards darkens to a deep brown, similar to picric acid. It is insoluble in cold water; undergoes no change in air; and can support, without inconvenience, the greatest variations in atmospheric temperature, between $-20°$ and $+50°$ C.

The neutral properties of trotyl, it will be seen, give it great advantages over picric acid. The latter, in virtue of its acid properties, forms metallic compounds, that is, picrates, which are very sensitive to shock. Lyddite (picric acid) has thus a great rival for gun-ammunition.

Kept submerged in water for many years, it does not lose its explosive force. Nor does it happen, as in the case of guncotton, that the greater the percentage of water the less the explosive force. Even in inflammability it does not suffer.

By means of gentle heating one can melt trotyl upon an iron plate without igniting it. Violent heating produces ignition. It burns slowly, however, without exploding, and with a black flame rich in carbon, similar to that produced by kerosene. Who would care to make this experiment with guncotton?

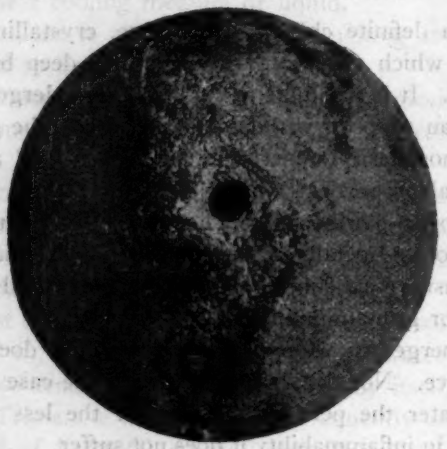
Placed on a cherry-red plate, trotyl burns slowly. Its great insensibility to shock, friction, and pressure makes it particularly appropriate for a military explosive. The shock produced by an 8-mm. rifle-bullet, with a velocity of 850 meters at 20 m. distance, going through a block of cast trotyl, does not cause the slightest alteration in it.

The pressure supported by trotyl in making up charges is 3,000 kg. per sq. cm. The friction and attrition produced by a steel saw has no influence whatever upon it. This is a very common operation in the manufacture of trotyl. Trotyl can also be turned in a lathe, like a block of wood.

Making a technical comparison as to the resistance to shock of different explosives, detonated by the percussion test in an impact testing machine, the hammer weighing 2 kg., we have:

Dry guncotton explodes at a height of	5 cm.
Wet guncotton explodes at a height of	50 cm.
Picric acid explodes at a height of	20 cm.
Trotyl explodes at a height of	80 cm.

Comparing the foregoing, we see that the insensibility of trotyl is four times greater than that of picric acid, and twice as great as that of the 20 per cent wet guncotton used in torpedo warheads.



TRAUZL'S LEAD BLOCK.

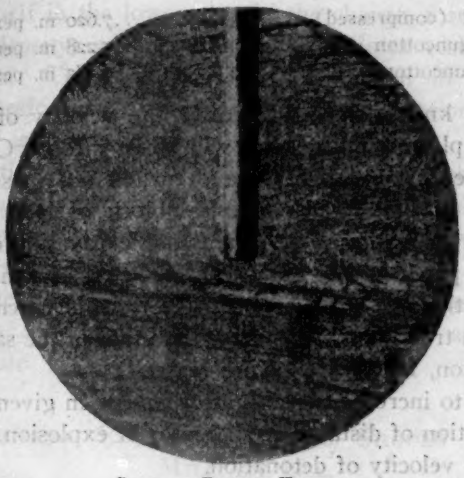
By the above comparison we can also see the great sensitiveness of dry guncotton, used as the priming charge in our torpedoes.

The density of loose trotyl is 0.75; of cast trotyl, as used in charges, 1.61; and of compressed trotyl, 1.50. The greatest density to which guncotton can be compressed is from 1.36 to 1.40, containing 18 per cent to 20 per cent of water, a great density in the compression constituting a grave peril.

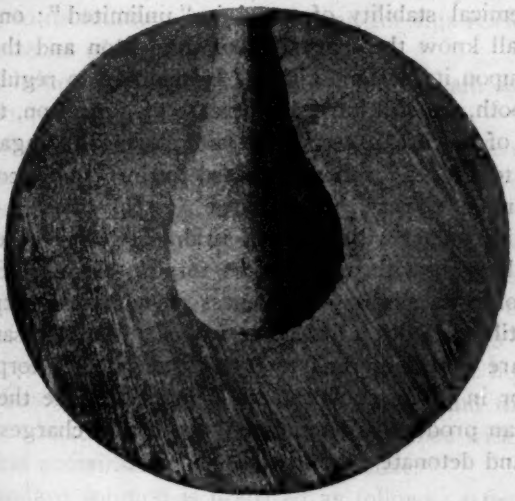
Pure trotyl melts at 80.°6 C., with considerable increase in volume, but without decomposition. Its specific gravity, when recrystallized in alcohol and dried, is 1.7, the same as of picric acid.

From all this we can deduce that a 45-cm. torpedo whose charge is 110 kg. of guncotton will contain, in the same volume, 127 kg. of trotyl. As a factor of density we have, as a consequence, the lessening of the distance from the center of

explosion of the charge in relation to the object destroyed, which gives a greater effect to the charge.



SECTION BEFORE FIRING.



SECTION AFTER FIRING.

Comparing again the two explosives used to-day in our navy in torpedo-charges, let us note more differences as to the velocity of detonation and force of explosion, important factors from the military point of view.

Let us determine experimentally the velocity of propagation of the detonation, by measurement in an iron tube.

Trotyl (compressed)	7.620 m. per sec.
Wet guncotton	5.228 m. per sec.
Dry guncotton	6.383 m. per sec.

Now it is known that the greater the velocity of detonation of a high explosive, the greater will be its effect. Our trials of the explosive force of trotyl have turned out most favorably. It produced in the Trauzl spherical block of lead (40 cm. in diam.), with a charge of 50 grams, an excavation of 1485 cc., and with 20 per cent wet guncotton, 1400 cc. From these trials we conclude that the effect or explosive force of 45-cm. torpedoes charged with trotyl is much greater than that of the same charged with guncotton, for the following reasons:

1. Ability to increase the weight of charge in given space.
2. Diminution of distance from center of explosion.
3. Greater velocity of detonation.
4. Greater explosive force.[2]

The chemical stability of trotyl is "unlimited"; on the contrary we all know the instability of guncotton and the dangers attendant upon its decomposition. In addition to regular inspections for both, we still have, in the case of guncotton, the special conditions of its care, preservation, and storing in magazines.

Loaded torpedoes, carried on board during action, constitute a serious danger. Trotyl, as a charge, lessens this. A projectile detonated in contact with a charge is almost certain to explode it. This will happen with any kind of torpedo-charge. But in the case of trotyl, its slight sensitiveness prevents this explosion, if the projectile explodes a little way from it. For the same reason splinters are not dangerous to trotyl charges. A torpedo, with a detonator in place, constitutes a danger, because the shock of splinters can produce a detonation. Guncotton charges are more sensitive and detonate more easily.

[2] General E. M. Weaver, U. S. A., in the preface to his *Military Explosives*, 3d Edition, states that TNT will not stand the shock of impact, and therefore passes from the class of shell-fillers. He states that its relative explosive force is 119,000 lbs. per sq. in., as compared with that of picric acid 135,800 lbs., and of Explosive D 124,600 lbs.; and also that it is more sensitive to shock than Explosive D.—R. E.

The percentage of water (from 18 per cent to 20 per cent) in guncotton charges, necessary to reduce their sensitiveness, is an inconvenience. When in store, the water in the charges slowly deposits itself in the lower part of the charge, forming strata of different density, which condition sometimes results in partial detonations. The compression of guncotton in single blocks should therefore be abandoned, as the dislocation of water is easier, and irregular densities will ensue.

The partial mine and torpedo explosions that occurred in the Russo-Japanese War are attributed to this irregular density in the charges. England, as a consequence, immediately abandoned the compressing of guncotton into a single block.

In charges of trotyl, the total mass is homogeneous, and does not absorb moisture, dispensing entirely with any inspection for this cause.

THE TECHNICAL REQUISITES TROTYL SHOULD SATISFY FOR MILITARY USE.

The chemical purity of trotyl is one of the principal factors favorable to its military application, and for this reason it ought to fulfil a series of technical specifications.

Trotyl, being a product of nitration, can contain as impurities both nitric and sulphuric acid.

Determination of Nitric Acid.—In order to determine the presence of this acid we must resort to a most sensitive reagent—diphenylamine.

Boil 10 grams of trotyl with 50 cc. of distilled water. Filter the cooled solution, adding fresh water to make up 50 cc. Take 5 cc. of this and dissolve it in a porcelain dish with 0.1 cc. of a solution of sulphuric diphenylamine (1 : 100) and 20 cc. of concentrated sulphuric acid. After five minutes the liquid, in its reaction, becomes violet, if nothing is wrong, and this reaction ought not to be stronger than the reaction obtained with a standard solution that contains 0.004 nitric acid per litre.

The standard solution is prepared as follows: 0.640 grams of potassium nitrate are dissolved in 1000 cc. of distilled water, and 10 cc. of this are again diluted in 1000 cc. of water.

Determination of Sulphuric Acid.—Boil 10 grams of trotyl in 250 cc. of distilled water. Leave it to cool and filter it. Draw

off 100 cc. of the previously filtered solution and acidulate it with some drops of hydrochloric, and precipitate it with a solution of barium chloride (1:10). There will result the formation of a precipitate. This calculated in SO_3 ought not to exceed .05 gram in 100.

Foreign Substances.—Dissolve 50 grams of trotyl in 200 cc. of hot benzol, and filter. The weight of the residue from this filtration ought not to exceed 0.10 grams in 100. The resulting ashes from calcination ought not to exceed 0.9 grams in 100.

The nitrogen determined by Kjedahl's apparatus ought not to be less than 18.30 per cent.

Point of Solidification.—Trotyl, previously dried, is placed 30 mm. from a Bunsen burner, and melted in a test tube. The amount of melted trotyl should be sufficient to cover the thermometer bulb for 2 cm. During cooling the degree of temperature should be observed, noting that before complete solidification, the thermometer rises a little, after remaining steady.

The temperature of solidification ought not to be below 79.°5 C., which corresponds to the fusing-point of pure trotyl (80.°6 C.).

The temperature correction indicated by the thermometer is made after the following formula:

$$K = \frac{n\,(T-t)}{6300},$$

signifying—

K = correction in degrees.

n = number of degrees of the thermometer above the melted mass.

$T-t$ = difference between temperature of air and of fusion.

Density.—For cast trotyl the density ought not to be less than 1.6; and for compressed, not less than 1.5. This should be determined by the flask method or the relation between weight and volume.

Moisture.—Place two samples of the pulverized trotyl in a furnace at 50° C. After four hours the difference in weight ought not to be greater than 0.1 per cent.

BLEIAZID OR NITRIDIDE OF LEAD.

Up to the present time, fulminate of mercury has always been used for detonators in torpedo-charges. The fulminate alone was first used in military pyrotechnics. Afterwards it was mixed with other explosive nitrates, such as trotyl, picric acid, tetranitromethylaniline, etc., in order to increase the force of the initial impulse.

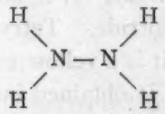
In navies, principally, the fact that fulminate of mercury is very porous and cannot explode when wet is a great inconvenience. That is, its easy absorption of moisture, due to its porosity, makes it decrease in density.

This new explosive (nitridide of lead) was introduced two years ago in military-explosive work, thanks to the labors of that eminent German chemist Dr. Lothar Wöhler of Darmstadt, who applied it to detonators.

Bleiazid, a German word made up of *Blei* (lead) and *azöe* (nitrogen), has the chemical formula PbN_6. It is a derivative of lead and hydrazoic acid.[3] It may be called lead hydronitride.

We had the good fortune to be present at the first lecture of Dr. Wöhler, accompanied by numerous practical experiments, at a formal meeting of the United Societies of German Chemists.

[3] This is undoubtedly HN_3, called by Curtino hydronitrous acid. Authority, Mendeleef. Some translators call it hydronitric acid—but it is believed they do so incorrectly—also hydrazoic acid and azoimide. It is hydrazine



in which three atoms of H are replaced by N, giving

and for this reason the name hydrazoic acid most clearly defines it.—G. W. Patterson.

Nitrohydric acid or hydrazoic acid, N_3H,* is very explosive itself and forms highly explosive salts. It furnishes a remarkably great volume of gas. It has not as yet received any important practical application. *Wisser's Explosive Materials,* D. Van Nostrand Company, 1898.—R. E.

Concerning the discovery of hydrazoic acid in 1890 by Curtino, the illustrious chemist Bertholet says: "It is one of the most notable and long-wished-for discoveries of the present epoch."

Hydrazoic acid is a violent and very sensitive explosive, that explodes when exposed to intense light. Nevertheless it is capable of practical use.

Specialists in military explosives persevered in their research of the compounds of this acid until they arrived at the lead hydronitride. Leading in this crusade were the eminent chemists Bertholet, Vieille, Noelting, Dennsted, and finally Wöhler.

The latter, in his lecture, practically demonstrated the greater velocity of reaction, in the detonation of lead hydronitride, over fulminate of mercury, as well as its superior resistance to moisture. This assurance of lead hydronitride resisting moisture, without losing its detonating effect, made it rapidly adopted as a detonator.[4]

In its natural state the sensitiveness of lead hydronitride to shock is the same as that of fulminate of mercury. Compressed, it is less sensitive in this regard than the fulminate. Its force of detonation, however, is twice as great. Hydronitride of lead holds its detonating properties, even when compressed at 6000 kg. per sq. cm., while fulminate loses this property at 700 kg. Lead hydronitride resists high temperatures better than its rival. It is insoluble in water, of a white color, and dust-like in appearance.

In making detonators, tetranitromethylaniline, or "tetryl" (not to be confounded with "trotyl"), is added to both fulminate of mercury and lead hydronitride. Tetryl is the abbreviation for tetranitromethylaniline. It is a yellow explosive substance, insoluble, stable like trotyl, and is obtained industrially by the nitration of dimethylaniline.

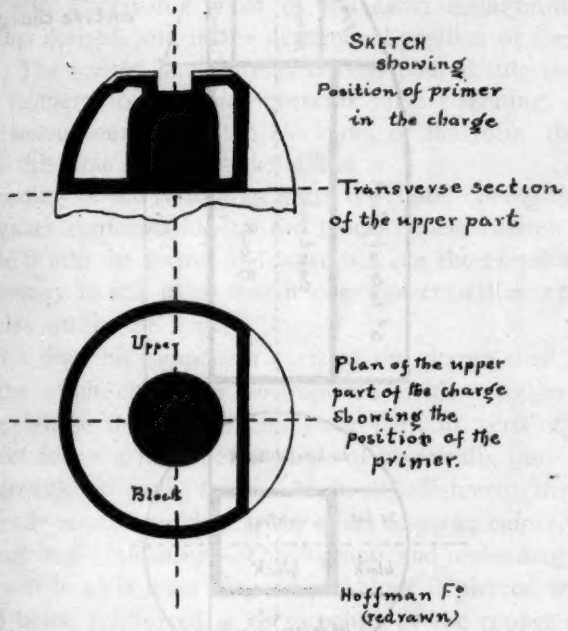
[4] That this material is to any extent in practical use as yet is considered doubtful, as there are many features about it that require considerably more experimentation. For example, the size of its crystals determines its sensitiveness. Cases are on record where even under water large crystals spontaneously explode, involving the whole mass in contact. Very fine crystals of it are less sensitive than fulminate, but to make it a practical material may involve a larger share of experiment than this paper would indicate.—G. W. Patterson.

EXPLOSIVE CHARGE OF TROTYL FOR TORPEDOES. COMPOSITION AND CONSTRUCTION.

I have given a description of the explosives that compose the charges of trotyl. We are now going to show how the whole charge is made up.

The charge of trotyl, like that of guncotton, is composed of detonator, primer, and explosive charge properly so-called.

The Detonator.—The detonator is composed of 1 gram of nitride of lead and 1.7 grams of tetryl. The manufacture is a

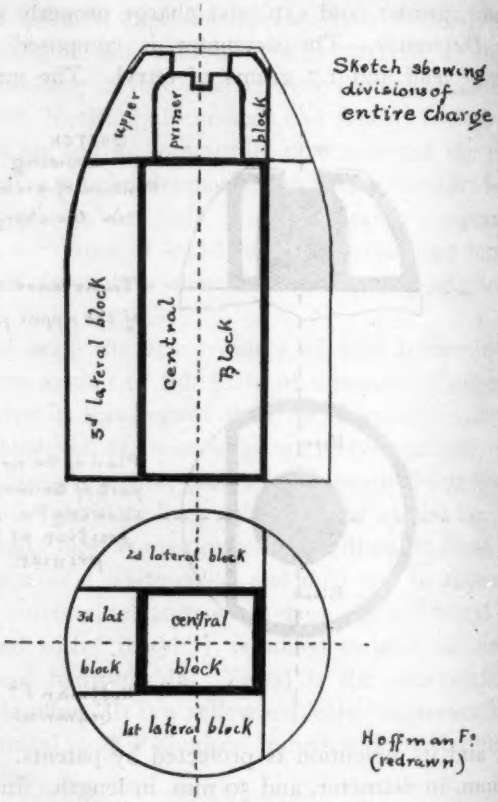


secret, and its invention is protected by patents. The detonator is 7.5 mm. in diameter, and 50 mm. in length. In the acceptance tests of detonators not one should be permitted to fail, after being left eight days in air that is saturated with moisture, and afterwards detonated in an impact machine. All should detonate with a fall of hammer of 81 cm., equal in practice to a torpedo-speed of 4 meters per sec. The firing-point which causes the detonation ought to enter 15 mm., more or less, into the interior of the detonator.

A fulminate of mercury detonator is unable to satisfy the above requirements of moisture absorption.

Primer Charge.—The primer charge is composed of trotyl, compressed to a density of 1.5, having a cylindrical form with a diameter of 12 cm. and a height of 17 cm. Its upper part is in the shape of an ogival, as shown in our sketch. The compression of this charge is made at 2000 kg. per sq. cm.

In guncotton charges the primer is indispensable, but experi-



ments show that, *compressed* trotyl being more sensitive to shock than *cast* trotyl, the detonation is transmitted with more facility and regularity to the main charge. Our sketch shows clearly the arrangement and position of the primer.

The Charge Proper.—The explosive charge, as shown in our sketch, is composed of five parts: an upper one, which takes the exact shape of the upper inside part of the head of the torpedo; a central part in the form of an oblong block; and others that

surround the central part. The division of the charge, as well as the number of component parts, has no effect whatever on the explosive force of the war-head.

The upper part of the charge has set in it the primer, which is completely fixed to it, the whole forming one block only.

In the manufacture of the block the following is the procedure:

The trotyl is melted in a copper flask in a vapor bath. It is afterwards poured into small flasks, all alike, and cooled until it is about at the solidifying point of the trotyl. It is then compressed into a cast-iron mold of the exact configuration and dimensions desired, and in the determined position of the primer charge. The melted liquid trotyl is then poured into the form, the low temperature of which prevents further melting. At the end of twelve hours draw the block out of the form, the block being by this time completely solidified.

The casting of the remaining parts is simple. Bring the form to the exact conformation of the blocks; melt enough trotyl; distribute it into the forms, and leave it. For the first few hours it is necessary to stir it, so that it does not crystallize and form air bubbles within the mass.

In order that the component parts of the charge shall be protected, the whole charge is electroplated[1] with a copper carton covering, whose thickness varies from 1/10 to 2/10 of a mm. This sheet forms a metallic envelope of chemically pure copper, and adheres closely to the trotyl. As an embellishment, the copper is chemically treated, producing the effect of *vieux cuivre*.

Loading and Unloading.—The loading and unloading of the torpedo war-head is most easy. Each block is pierced with two threaded holes, reinforced at these points by the copper electroplate. The handles which accompany the war-head permit withdrawal when necessary, with the greatest facility, by merely screwing them into the holes.

Care and Preservation of Charges and Detonators.—No especial precautions whatever are necessary relative to the care of trotyl charges. Their chemical stability is unlimited. Atmospheric temperature has no influence whatever on the charges,

[1] After the rigid specifications required for TNT, the wisdom of this procedure of copper plating it, using a liquid bath that is usually acid, seems somewhat questionable.—G. W. Patterson.

and it is thus practicable to keep them in any kind of magazine or storeroom.

It is advisable, however, to avoid high temperatures, in the interest of conservation, observing also the fusing-point of trotyl (80.°6 C.). High temperature expands the copper envelope of the charge, causing it to lose its adherence. This results in a loss of the effective military value of the envelope. A temperature of 45° C. as a maximum should be the standard practice.

In case of accident to the ship or flooding of storerooms, the trotyl charges suffer nothing of their explosive power, even if months under water.

The detonators (of PbN_6) ought to be cared for only as ordinary detonators.

The foregoing shows us that chemistry applied to the military art marches in these last years with gigantic strides. A few years ago the rudiments of chemistry were scarcely necessary to a comprehension of military pyrotechnics; to-day this subject cannot be studied without the most profound research into this science.

EDITOR'S NOTE.—Germany, Russia and Brazil are reported to have adopted TNT for mines and torpedoes.

Density.—As crystals this is .8 to 1.0; melted, it is 1.5; and treated in special manner, it reaches 1.62. A pressure of 18 tons per square inch can be used when its density becomes 1.7. Picric acid can be subjected to 5 tons per square inch pressure, but its density fused or melted is high, 1.65.

Comparisons with Other High Explosives.—Picric acid or shimose stains the skin yellow, is very poisonous and difficult to work with, while it forms metallic salts that are very explosive and far more dangerous than the acid itself. The alkali picrates are practically as violent as fulminate of mercury. TNT is still under investigation in the United States. It does not stain the skin; is non-poisonous; forms no metallic compounds; is absolutely non-hygroscopic and perfectly stable, both physically and chemically; is not sensitive to blow, shock, or fire; when heated gradually it volatilizes with an explosion; however, it lacks sufficient oxygen for complete combustion.

Authorities.—C. E. Bichel, *Rivista di Artigliera e Genio,* I. Rudeloff.

The detonator—hydronitride of lead—has not been experimented with to any extent as yet, but possibly does offer a field if the results given in the article are accurate and the result of exhaustive experiments. It is not believed that as yet it is in practical use to any extent. As Mr. Patterson notes, however, its sensitiveness is too non-uniform as yet to make one certain of it.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A HALF CENTURY OF NAVAL ADMINISTRATION IN AMERICA, 1861-1911.

By CHARLES OSCAR PAULLIN.

III.

THE SECOND ADMINISTRATION OF GIDEON WELLES, 1865-1869.

The ending of the Civil War and the beginning of Welles's second term in the department were almost coincident. In the spring of 1865 rumors that Welles would not remain in the cabinet were current in New England. He, however, continued in office during Lincoln's brief second administration and throughout the administration of Andrew Johnson, resigning on March 3, 1869. Of Lincoln's original cabinet, Secretary of State Seward was the only other member who held his post for eight years, he too serving until the end of Johnson's administration. Welles's second administration was marked chiefly by the withdrawal of the fleets from the duties of the war, the re-establishment of the foreign squadrons and the reduction of the naval matériel and personnel to a peace footing.

On June 1, 1866, Gustavus V. Fox retired from the position he had held in the department since July 31, 1861, and William Faxon, the chief clerk of the department, was promoted to the assistant secretaryship of the navy. On the retirement of Faxon at the close of Johnson's administration this office was discontinued, since Congress refused to appropriate for it. On May 26, 1866, Congress authorized the appointment of an additional Assistant Secretary of the Navy to serve for a period of six months. Fox was appointed to this new position, which was created for him and for a special purpose. On May 16 Congress had passed a resolution of greeting to the Emperor of Russia, congratulating him on his escape from assassination. President

Johnson selected Fox to carry a copy of the resolution to the Russian ruler; and, in order to add some dignity and pomp to his mission, a temporary assistant secretaryship of the navy was created for him. In June, 1866, he took passage at St. Johns, Newfoundland, on the *Miantonomoh,* the first American ironclad to cross the Atlantic, and proceeded to Cronstadt. He was welcomed with festivities and extraordinary courtesies and attentions not only at St. Petersburg, but at Moscow and other Russian cities. This successful mission made a fitting termination to his brilliant career in the Navy Department.[71]

When Faxon vacated the position of chief clerk of the department to become Assistant Secretary of the Navy, his place was taken by Mr. Edgar T. Welles, a son of the Secretary, who had been filling a clerkship in the Secretary's office. Since leaving the department in 1869, young Welles has achieved distinction in New York City as a man of affairs. The ending of the war caused little or no reduction in the regular clerical force of the department. The number of clerks and draftsmen in 1865 was 66; in 1866, 69; and in 1869, 62.[72] After several attempts had been made to establish permanently the office of solicitor and judge-advocate general of the navy, it was discontinued in 1870.

It is recollected that the Bureau of Navigation owed its origin largely to Rear-Admiral C. H. Davis, who designed it to be the scientific department of the navy. On April 28, 1865, the Office of Detail was placed in charge of the Bureau of Navigation. The resulting establishment was given the official title of the "Bureau of Navigation and Office of Detail." This was the first step towards the transforming of this bureau into a bureau of personnel. The incongruous union formed no part of Davis's plans. Indeed it proved fatal to them. In course of time the scientific work of the Navy Department fell to other bureaus, and the duties of an office of detail became the chief and characteristic part of the work of the Bureau of Navigation—a term that is now a misnomer. This transformation is one of the most significant steps in the evolution of our present navy system.

In 1863 Davis recommended the establishment of a hydrographic office to undertake a somewhat similar work to that per-

[71] U. S. Statutes at Large, XIV, 54, 355; Ann. Rept. of Sec. of N., 1866, 13-14; Loubat, Fox's Mission to Russia, 9-424.

[72] Navy Registers, 1865, 1866, 1869.

formed by Maury's Hydrographical Office. Finally, largely through his instrumentality, a law was passed in 1866 creating the "Hydrographic Office" and attaching it to the Bureau of Navigation.[73] The new office was quartered with the Nautical Almanac Office, in the Tayloe Building, in Washington. This latter office had been recently removed from Cambridge, Massachusetts, to the capital. For several years the growth of the Hydrographic Office was slow.

In 1866 Secretary Welles recommended the establishment of an additional bureau in the department, which was to have charge of all the duties of the Federal government relating to the enlisted force of the navy and the seamen of the merchant service. The creation of this bureau was a part of a comprehensive plan of Welles to elevate the character and status of the man-of-wars' men by giving them the privilege of retirement from the navy with pay, an extensive education on school-ships and at the Naval Academy, and a chance of promotion to the naval line.[74]

Both during and after the war attempts were made to establish in the Navy Department a board composed of naval line officers and vested with large advisory and directive powers; and several bills were introduced in Congress providing for a board of this character. The general and flexible grant of powers contained in these bills gave the proposed organization ample room to grow and expand. It was to occupy a position in the departmental hierarchy between the bureaus and the Secretary of the Navy. The establishment of a board of this sort met with much opposition. Certain civilians opposed it because it would diminish the civilian and increase the naval influence in the department. The Secretary of the Navy discovered in it an attempt to rule the navy by means of a clique, such as he had destroyed when he entered the department in 1861. The friends of the bureau system saw in it an undue subordination of the naval bureaus. The staff officers feared that the proposed board would bring about the complete supremacy of the line officers in naval administration.

The first measure providing for a naval board of the general character indicated above was introduced in the House by Henry Winter Davis, of Maryland, in 1864. It authorized the establish-

[73] Davis, Davis, 283.
[74] Ann. Rept. of Sec. of N., 1866, 33-36.

ment in the department of a "Board of Naval Administration." Nothing came of this measure. In February, 1865, Davis offered an amendment to the annual appropriation bill, providing for the organization of a "Board of Admiralty." This was to consist of the vice-admiral, one rear-admiral, one commodore, one captain, one commander and one lieutenant-commander. Its presiding officer was to be either the Secretary of the Navy or the senior officer of the board. It was to deliberate and to give advice on naval organization and legislation, the construction, equipment and armament of vessels, the navy-yards and other naval establishments, and the direction, organization and discipline of naval forces in time of war. All plans for new ships, guns and engines were to be submitted to it. The proposed board seems to have been modelled on the British Board of Admiralty.

In 1867, 1868 and 1869 the Grimes Navy Bill was before Congress. This provided for a "Board of Naval Survey," which, according to one of the later forms of the bill, was to consist of three line officers not below the rank of rear-admiral. The members of the board were to be appointed by the President for a term of four years. An officer not below the grade of commander was to act as its secretary. The Bureaus of Medicine and Surgery and Provisions and Clothing were to be abolished. The naval staff considered the Grimes Bill inimical to their interests. It passed the Senate on March 16, 1869, but it failed to become a law.[75]

The first measures of naval retrenchment at the close of the war were taken soon after the fall of Fort Fisher in January, 1865, in anticipation of the collapse of the Confederacy. In February the commanding officers of the blockading squadrons were ordered to send north all purchased vessels out of repair and all unnecessary naval stores, and to use the greatest care in decreasing their expenses. About May 1 orders were issued to reduce the naval squadrons in domestic waters one-half; and near the close of the month further reductions were directed to be made, until the entire force of vessels in commission should not exceed 100. Early in July the blockading squadrons were reduced to 30 ships. On July 31 the Potomac flotilla, and on August 14

[75] Congressional Globe, 1863-1864, p. 1531; 1864-1865, pp. 601-602; 1869, pp. 63-64, 86-87; Army and Navy Journal, II, 389, 393; IV, 475; V, 301, 329; Clymer, Naval Staff Rank, 119-120, 157-170; Diary of Gideon Welles.

the Mississippi flotilla, were discontinued. Meantime, the two Atlantic and the two Gulf squadrons had been combined. In January, 1865, the vessels of the blockading squadrons numbered 471 and carried 2455 guns, in December they numbered 29 and carried 210 guns.[76]

During 1865 most of the vessels that had been purchased and some of those that had been built were sold. Many vessels, having been procured for special purposes, were not fit to become permanent acquisitions of the navy. By May 6, 1868, 429 vessels had been disposed of. In December of that year only 81 vessels were in commission; 125 vessels were either in ordinary or were in process of construction. Several ships which were on the stocks at the close of the war were finally launched, and others were never completed. Most of the ironclads were laid up in ordinary, chiefly at League Island, but also at Boston, New Orleans, Mound City and San Francisco. As the vessels were put out of commission, they deposited their ordnance and supplies at the several navy-yards, which were soon crowded to overflowing with naval stores of all sorts. These vast quantities of warlike materials were gradually exhausted by sale, use or decay. The ordnance was collected chiefly in the Northern navy-yards. Its most important depot was a gun-park at the New York yard, which had a capacity for 2000 cannon. The value of the ordnance and ordnance stores remaining on hand in 1868 was about $17,000,000. Large quantities of unserviceable ordnance were sold.[77]

In the spring of 1865 the department took measures for the re-establishment of the foreign squadrons. A course of active cruising was ordered, so that the flag which had been so long withdrawn might be again exhibited in every important port where American commerce penetrated. For four years the commercial interests of the United States in foreign waters had been left without any protection, except such as a few isolated cruisers could give. The old method of hiring storehouses in foreign ports and of appointing storekeepers to take charge of them was now abandoned. These storekeepers had sometimes made their offices a means of traffic for their individual advantage. Their duties were now vested in the paymasters of the navy, and storeships took the place of storehouses. Changes were also made in

[76] Ann. Rept. of Sec. of N., 1865, ix-x.
[77] Ann. Rept. of Sec. of N., 1868, 71-72.

the number and distribution of the naval squadrons. The Mediterranean and African squadrons were supplanted by the European squadron, whose cruising grounds included the Mediterranean and the west coast of Africa. The Brazil squadron was renamed the South Atlantic squadron. The Pacific Ocean was divided between two squadrons. The cruising grounds of the Asiatic squadron were made to include the waters off the East African coast; and those of the former home squadron were divided between the North Atlantic and the Gulf squadrons.[78]

By October, 1866, the number of enlisted men in the navy had fallen to 13,600. One year later this number had been further reduced to 11,900. At the close of the war several rendezvous and recruiting stations were discontinued. In 1865 most of the volunteer officers were honorably discharged, and they returned peaceably to their homes and occupations. During the war a disposition was manifested to reward the most efficient volunteers by giving them permanent commissions in the regular navy. This step was recommended by Secretary Welles in his annual report for 1863. The same subject came up again after the war, and it was decided that in view of their faithful and meritorious conduct the volunteers should be rewarded. This decision was not favorably regarded by some of the regular officers, between whom and the volunteers considerable rivalry and jealousy existed. On July 25, 1866, an act was passed providing that five lieutenant-commanders, 20 lieutenants, 50 masters and 75 ensigns might be appointed to the line of the navy from those volunteer officers who had served not less than two years and who had been honorably discharged or were still in the service. The act further provided that a board of naval officers should examine the candidates and select those who were most meritorious in character, ability, professional competency and honorable service. Welles at once appointed the board, with Commodore S. P. Lee as senior member. It began its delicate and arduous task at Hartford, Connecticut, on September 5, 1867, and continued to sit at intervals for more than a year. The first names that it recommended were sent by President Johnson to the Senate in December, 1867; these were followed in 1868 by other names.[79]

[78] U. S. Statutes at Large, XIV, 222-223; Ann. Rept. of Sec. of N., 1866, 31, 151; 1867, 22-23, 117.

[79] Ann. Rept. of Sec. of N., 1866, pp. 12-22.

Positions for the fortunate volunteers were created in the lower ranks by increasing the total number of commissioned officers of the navy and by promoting the regular officers. The act of July 25, 1866, increased the number of rear-admirals from 9 to 10, commodores from 18 to 25, captains from 36 to 50, commanders from 72 to 90, lieutenant-commanders and lieutenants, each, from 144 to 180, and masters and ensigns, each, from 144 to 160. The regular officers were promoted to fill the additional numbers in the several grades in accordance with their merit. This act created also one additional rank, that of admiral. But a single officer was established in it. He was paid an annual salary of $10,000 and was permitted a secretary. Farragut was at once appointed to the new position, which was designed for him, and Porter succeeded Farragut as vice-admiral.[80]

The above act led to the rapid advancement of many young officers, even to the rank of lieutenant-commander. The naval staff did not fare as well as the line. After the war 50 additional paymasters were authorized and the naval constructors and the first and second assistant engineers were made commissioned officers. As no increases were made in the medical and engineer corps, the surgeons and the engineers felt that justice had not been done them. By the promotion of many young men of the line, the rank of their fellow-officers of the staff was relatively decreased. Rather than bear this indignity, some of the ablest engineers resigned from the navy. Of this class, Robert H. Thurston, the late director of Sibley College, Cornell University, was a conspicuous example. There were much strife and rivalry between the several corps for honors, preferment and increased pay.[81]

In 1866 the number of men in the marine corps was about 3600. By October, 1868, this number had been reduced to about 2700. As yet no new barracks had been erected in place of those destroyed by the Confederates at the Norfolk and Pensacola navy-yards. In 1869 the commandant of the marine corps was given the rank and pay of a brigadier-general of the army.[82]

The experiences of the war demonstrated that most of the navy-yards were too limited in area for the needs of the navy.

[80] U. S. Statutes at Large, XIV, 222-223.
[81] Bennett, Steam Navy, 607-608.
[82] U. S. Statutes at Large, XIV, 517.

In 1865 Welles said that none of them presented the requisite conveniences and facilities for fitting out in a rapid and efficient manner more than a single vessel at a time, and that with the exception of the yards at Mare Island and Norfolk not one of them had sufficient room to erect the works necessary for its present wants. He endeavored to increase the areas of the Northern yards, and small additions were made to those at Philadelphia, New York and Boston. In April, 1866, Congress appropriated $105,000 for the purchase of Seavey's island, near the Portsmouth navy-yard. This was at the rate of $1000 an acre, a much larger price than private individuals would have paid. In 1867 a navy board prepared plans for the island's improvement. During the same year the Bureau of Ordnance acquired from the Surgeon-General of the Navy 15 acres at Chelsea, Massachusetts, for a naval magazine. The attempts to establish a navy-yard on the Mississippi, to which reference has previously been made, failed. The naval station at Mound City, Illinois, however, was continued for several years after the war.

After the cessation of hostilities, Welles continued his agitation in behalf of the acceptance of League Island as a site for a navy-yard adapted to the needs of an iron navy. In 1865 he obtained permission from the city of Philadelphia to lay up in ordinary in the back channel of the island several of the ironclads. Finally, on February 18, 1867, an act was passed authorizing the Secretary of the Navy to accept League Island, provided a board of officers to be appointed by the President should recommend its acceptance. A board, of which Rear-Admiral C. H. Davis was president, was constituted, and it reported unanimously in favor of receiving the gift. Difficulties now arose respecting a title, but these were finally removed, and the island, which contains 923 acres, became the property of the United States in December, 1868.

The friends of New London, who had succeeded in delaying the acceptance of League Island, were rewarded for their perseverance. In the naval appropriation bill of March 2, 1867, under the suspicious heading, "Navy Yard at Washington," was a clause authorizing the Secretary of the Navy to accept a deed of gift, when offered by the State of Connecticut, of a tract of land near New London, with a water front of not less than one mile. This land became the property of the government on June

27, 1868. It was situated three miles north of New London, on the Connecticut River, and contained 80 acres.[83]

Before 1861 a tendency was manifested towards the extension of the bureau system of the Navy Department at Washington to the several navy-yards. The decentralization of administration in the central office led logically to decentralization in the branch establishments. The war seems to have increased this tendency. Each bureau came to exercise more and more control over the facilities for the performance of its work in the navy-yards. On July 1, 1868, Secretary Welles extended the bureau system to the several yards. He discontinued the naval storekeepers and directed them to turn over the stores and materials in their keeping to the local representatives of the several bureaus. The new system, it was believed, would fix the responsibility for the care of the naval stores upon those most interested in their preservation. It was not, however, adapted to secure unity and correlation in the work of the yards.[84]

Welles's experiences during the war led him to believe that the system of making naval purchases through navy agents whose total commissions were limited led to abuses, tended to corrupt the subordinate employees of the navy-yards, and discouraged and drove away honest dealers. In 1865 he discontinued the navy agents, and vested their duties in naval paymasters. The transfer of these places to naval officers caused quite a commotion among the politicians. The office of navy agent was first established in 1776.

Beginning with the fiscal year 1866, the naval expenditures fell off rapidly, but not as fast nor as much as one might have expected. When once the expenditures of a Federal bureau or department are greatly augmented, they never fall quite as far as the old level when the cause of the augmentation ceases to operate. When the war came to an end in the spring of 1865 the department had many contracts with private builders for vessels, engines, ordnance and various naval materials. Many of these had to be carried out. The construction of several ships which were upon the stocks was continued. At this time all prices were abnormally high owing to the depreciation of the currency. The

[83] Ann. Rept. of Sec. of N., 1866, xx; 1867, 18-20; 1868, xxvi; U. S. Statutes at Large, XIV, 396, 489.

[84] Ann. Rept. of Sec. of N., 1868, xxi; Preble, Boston Navy-Yard, 390.

net expenditures of the navy for the fiscal years from 1865 to 1869 were as follows: 1865, $123,000,000; 1866, $43,000,000; 1867, $31,000,000; 1868, $26,000,000; and 1869, $20,000,000.[85] For a period of peace these expenditures were excessive. In 1867, however, Welles carried to the "surplus fund" $65,000,000. This was derived from the unexpended balances of naval appropriations and from the sale of vessels and other naval property.

The expenditures of the navy appeared to be extraordinarily high to the 44th Congress, which met in December, 1867. A considerable divergence between the naval program of this body and that of the Secretary of the Navy was soon found to exist. Welles did not propose to reduce the enlisted force to its numbers before the Civil War, but wished to keep it at about 15,000 men. He would enlarge and improve the navy-yards, adapt them to the needs of an iron navy, and equip them with machinery for the repair and manufacture of hulls and engines. He would retain the larger ships and the ironclads, and complete the vessels that were upon the stocks. On the other hand, the naval program of the 44th Congress called for a vigorous retrenchment. The navy was to be reduced, as far as possible, to its old levels. This Congress therefore fixed the number of the enlisted men at 8500. It declined to make appropriations for the improvement of the navy-yards or for the completion of the vessels building in them. As a result of the new policy, the number of men employed in the yards was reduced between November, 1867, and July, 1868, from about 11,000 to about 6300, almost one-half.[86] In accordance with the wishes of Congress, Welles reduced the naval estimates of his annual report for 1867 more than $22,000,000. The abruptness with which this policy was decided upon caused severe losses to the department. Uncompleted vessels decayed upon the stocks, the engines that had been built for them were rendered useless, and the ironclads and other naval property at the yards greatly deteriorated in value for lack of proper care. This is by no means the only instance when the navy has suffered from a want of proper co-ordination and correlation of the work of the executive and legislative departments of the Federal government.

The period 1865-1869 was a time of confusion in the naval counsels. Wide differences of opinion upon the problems of

[85] Sen. Ex. Doc., 45 Cong., 1 sess., No. 3, 157.
[86] Congress Letters, XIV, 371-373, 382-393, 437.

naval construction existed. Chief-Engineer Isherwood and his work were severely criticised by naval officers and other critics. One of the service journals was outspoken and persevering in its attacks on him. It is now clear that his critics were more or less biased, and applied standards of judgment fast becoming obsolete. In some respects Isherwood and his ships were in advance of their time. Two of his fast cruisers, the *Wampanoag* and *Ammonoosuc,* were commenced in 1863, but were not completed until several years after the war. After the trial trip of the *Wampanoag,* upon which she developed a speed of 17.75 knots an hour, more than 21 years elapsed before her speed was equaled by an American naval vessel, the steel cruiser *Charleston* in September, 1889. More than 11 years elapsed before her speed was equaled by an ocean steamer, the *Arizona.* In 1869 the *Wampanoag* was condemned by a board of naval officers in a report that is now said to be a "veritable curiosity of professional literature." She never went to sea again, but was permitted to decay at the wharves of the New York navy-yard and the New London naval station. Finally in February, 1885, she was sold for three per cent of her original cost.[87]

The scientific work of the navy, which was so important a feature during the period 1842-1861, was in large part suspended during the war. Many administrative duties on shore occasioned by the war, however, fell to the naval officers. The number of commissioned line officers, active and retired, employed on special duty in January, 1865, was 92. Thirty-nine engineers were employed in constructing ships and engines, and 14 were attached to the Bureau of Steam Engineering. After the war the scientific work of the navy partially revived. The Hydrographic Office was created, and the Naval Observatory entered upon its golden era. In 1868 shore-duty as a legitimate employment for naval officers was recognized in a general order of the department directing that a fixed period of sea-service should be followed by a similar period of shore-duty and that the two periods should alternate with each other throughout an officer's active career. This order has been called the "first step in the decadence of the navy which followed the Civil War."[88]

[87] Bennett, Steam Navy, 553-583.
[88] Davis, Davis, 74.

The subjects of a naval code, rules and regulations for the navy, naval uniform, and assimilated or relative rank received from time to time the attention of the Secretary of the Navy. On July 17, 1862, admonished by the needs of the war, Congress established a new naval penal code. A joint resolution of Congress of March 3, 1863, provided for the appointment of a commissioner to codify the naval laws. Mr. Charles B. Sedgwick, who was selected to fill the new office, completed his work on March 1, 1864. His code consisted of 66 pages, and was very comprehensive. It embraced regulations respecting the organization of the Navy Department, the personnel and matériel of the navy, the Naval Academy, and miscellaneous topics. It, however, failed of adoption.[88] On October 18, 1865, Welles issued a new edition of the naval regulations, comprising 344 octavo pages. In 1862, 1864 and 1866, he issued new editions of the regulations on naval uniform. The regulations of 1866 contained 17 colored plates showing the required articles of dress.

During the administration of Secretary Welles the animosities and jealousies between the line and the staff officers respecting assimilated or relative rank flamed up with increased heat. Ill-feelings had arisen under the enforcement of the orders of the department granting assimilated rank to the surgeons, paymasters and engineers. The staff accused the line of reducing these orders to their lowest terms, and of being unable to discover occasions when they were applicable. On March 13, 1863, Welles issued an order that greatly intensified the feelings between the two classes of officers. He increased the assimilated rank of the surgeons, paymasters and engineers, adapting it to the new ranks of the line established by the act of July 16, 1862. He also specified the occasions when the officers of the line and of the staff should take precedence according to their assimilated rank: "In processions on shore, on courts-martial, summary courts, courts of enquiry, boards of survey, and all other boards." This order was a thorn in the flesh of the line, and they petitioned the Secretary of the Navy to revoke it. Its enforcement undoubtedly might at times produce confusion, for a surgeon on board of a ship might outrank the captain. In 1865 Welles appointed a

[88] U. S. Statutes at Large, XII, 600, 825; House Ex. Doc., 38 Cong., 1 sess., No. 47.

board, with Vice-Admiral Farragut as president, to consider the rank and pay of the staff, but it accomplished no permanent results. After the war several bills were introduced in Congress giving the staff the recognition that it desired, but they failed of passage. The line was particularly determined to procure the rescinding of Welles's famous order of March 13, 1863, and in 1869 it succeeded.[80]

IV.

THE NAVY DEPARTMENT UNDER GRANT AND HAYES, 1869-1881.

The period 1869-1881 was a time of reaction, naval decline and wide-spread indifference to the needs of the navy. Tired of war and the instruments of war, the country turned its attention to industry and money-making and became apathetic in respect to naval affairs and the national defense. This feeling was naturally shared by Congress and the executive departments. A huge national debt and uncertain public finances admonished the Federal government to be economical in its expenditures. Fortunately, the nation remained at peace, and its unprogressive policy was by no means entirely bad, for when the expansion of the navy came in the last two decades of the nineteenth century advantage could be taken of the great progress made by the European navies in the 20 years succeeding the Civil War. Such was the rapid improvement in naval construction and armament that, had a navy been built in the seventies, it would have been in many respects obsolete in the nineties. The United States ran the risk of defeat in case of conflict, but with its usual good fortune succeeded in avoiding war. If the *Virginius* episode of 1873-1874 had developed into a Spanish-American war, which at one time seemed quite possible, its events would have doubtless been far different from those of the war of 1898 when the nation possessed a modern navy.

During the administrations of Grant and Hayes, party feelings ran high, and often determined the acts of Congress and the executive departments. Under Grant there were considerable politics and corruption in the civil service and extravagance in the administration of the Federal government, and the Navy Department did not escape these evils. Those who were in charge of

[80] Clymer, Naval Staff Rank, 20; *Washington Chronicle*, November 16, 1869.

the government were properly blamed for its administrative and legislative abuses. To some extent, however, the evils from which Grant's administration suffered were an outgrowth of the Civil War and the early years of Reconstruction. They struck root during this time of commotion and came to baneful flower in the seventies.

For almost the whole of the period 1869-1881 the navy was administered by Secretaries George M. Robeson and Richard W. Thompson. With the exception of the first three and a half months, Robeson served throughout the whole of Grant's two terms. Thompson came in with Hayes in March, 1877, and resigned some two months before the end of his chief's administration in March, 1881. Robeson's predecessor, Adolph E. Borie, of Pennsylvania, and Thompson's successor, Nathan Goff, of West Virginia, were not in office long enough to have much influence upon the work of the department. The brief administration of Borie, extending from March 9 to June 25, 1869, is, however, noteworthy for the important part played in it by Vice-Admiral David D. Porter.

Borie was somewhat passed the meridian of life, and had no special liking or fitness for his task. He was one of the surprises of Grant's first cabinet, and owed his selection to his friendship with the President. Hugh McCulloch, who was Secretary of the Treasury under Johnson, wrote:

> There was a good deal of astonishment at the nomination of Adolph E. Borie to be Secretary of the Navy. When it was understood that his name had been sent to the Senate, the inquiry everywhere was, "Who is Adolph E. Borie"? Outside of Philadelphia, where he lived, he was unknown, and there he was known only as a citizen of wealth and good social standing. It was reported that only one senator had ever heard of him until his name was read by the secretary. To himself his appointment was as great a surprise as it was to the public. The place was undesired by him. He had no aptitude for the business he was called upon to perform, and he was glad to retire from public life after an experience, if such it could be called, of three months.[91]

On March 9, 1869, Borie took possession of the Navy Department, and in order to make the acquaintance of his chiefs and to gain some notion of the organization over which he was to preside he made the rounds of the bureaus. He was accompanied by

[91] McCulloch, Men and Measures, 350.

Vice-Admiral Porter, and, according to Rear-Admiral John A. Dahlgren, when they reached the Bureau of Ordnance of which Dahlgren was chief, Porter "stepping aside told me that Grant said he should run the machine as Borie's adviser." On March 12 Borie, under the direction of Grant, issued an order to the effect that "all matters relating to the navy coming under the cognizance of the different bureaus will be submitted to Vice-Admiral Porter before being transmitted to the Secretary of the Navy."[88] Porter was also given authority to transact the official business of the department. During Borie's administration many letters issuing from the Secretary's office were signed "David D. Porter, Vice-Admiral, by order of Secretary of Navy," or "For Secretary of Navy." Still other letters, which were signed by the Secretary, were prepared by the Vice-Admiral. For most purposes Porter was the Secretary of the Navy.

With the best of intentions, the Vice-Admiral ran the navy in a somewhat arbitrary and extravagant manner. Basing his act on a decision of the Attorney-General, he cancelled Welles's order of March 13, 1863, in respect to the relative or assimilated rank of staff officers, and added much fuel to a flame that never dies out. He organized boards to inspect the navy-yards and naval vessels, and to make recommendations thereon. He greatly increased the force of artisans and laborers at the navy-yards, and began the repair of numerous vessels—a much-needed work. Many of the steamers were provided with new rigging and were equipped with full sail-power, the use of sails instead of steam being a favorite notion of Porter. He inaugurated an administration of naval reform. Not content to make his reforms gradually, he attempted to introduce within a few weeks various changes in isolated matters, which he had long had at heart. While Gideon Welles issued only five general orders during the last two years of his administration, his successor during his short term issued 45. Porter was the principal author of Borie's orders, which covered a wide range of subjects, and varied somewhat in their usefulness. Professor J. R. Soley says that some of them were "rather fanciful, some of them were ill-timed, and some were distinctly harmful."[89]

[88] Dahlgren, Dahlgren, 642; Congressional Globe, 1870-1871, pp. 69-70.
[89] Soley, Admiral Porter, 458-460; Congressional Record, V, 1868.

Porter was not a successful administrator. His hand was too heavy for the finesse of a skilful and tactful executive. The qualities that win battles at sea are not always those which count for most in the Navy Department. The Vice-Admiral was too good a sailor to make a good landsman. As an administrator, he was often impatient, biased and impracticable. The following extract taken from the diary of Rear-Admiral Dahlgren shows the honest, plain-speaking, bluff, old sea-officer at work in the department: "Porter busy getting documents for the Secretary to sign. I told him I would not remain in the Bureau. Reasons, the report of the Committee. He damned the Committee, and said he would whip them; that I must not think of leaving."[84]

The Vice-Admiral's large exercise of authority naturally aroused much opposition, and on the coming of Robeson in July, 1870, his power and influence rapidly waned. The new Secretary was not willing to efface himself after the manner of the old. Porter soon wiped the dust of the Navy Department from his shoes. In 1876 he testified that he had not been inside the department four times in six years. His position was an anomalous one. While holding the highest rank in the navy, officers of inferior rank as bureau chiefs were much more influential than he. Isolated and neglected, he was forced to stand aloof from the main currents of naval administration. As had Farragut before him, he felt hurt that he was not more consulted and his services more largely utilized by the department.

While Porter from 1871 until his death in 1891 was well removed from the center of naval affairs, his connection with the business of the navy did not entirely cease. On November 16, 1870, Secretary Robeson addressed a letter to him for the purpose of stating more clearly his duties as admiral, to which office he had been promoted on the death of Farragut. Under Porter's supervision were now placed the inspection of ships in commission, of ironclads and wooden vessels laid up in ordinary, and of navy-yards and naval stations. Upon all of these matters the Admiral was directed to report regularly to the Secretary of the Navy. The trial of ships of war under sail and steam were also placed under his direction. In 1881 he was given supervision over the training of apprentices. For many years the Admiral

[84] Ammen, The Old and the New Navy, 461-462; Dahlgren, Dahlgren, 642.

made annual reports to the Secretary of the Navy. In these he discussed with great freedom and fullness the condition of the naval matériel and personnel. He plainly and fearlessly pointed out the lamentable state of the American fleet, and instituted comparisons between it and the navies of Europe showing its great inferiority to them. In the seventies, when the apathy and indifference of Congress and the people in respect to a naval armament were greatest, Porter vigorously and insistently declared the country's need of a new navy. His voice was as one crying in the wilderness.

Borie resigned his office on June 25, 1869, and on the same day George M. Robeson, of New Jersey, was commissioned by the President. As the Senate was not then in session, he was confirmed and recommissioned on December 8. He remained in the department until March 12, 1877, a little less than seven years and nine months. With the exception of Gideon Welles, he served longer than any other Secretary of the Navy. Richard W. Thompson, of Indiana, took charge of the department on March 13, 1877, and resigned his office on December 30, 1880. The careers of neither Robeson nor Thompson had been such as to specially fit them for their naval duties. Robeson was about 40 years of age when he become Secretary of the Navy, and Thompson was 69 years. Robeson came from New Jersey, and owning some land on the seacoast was at least familiar with the look of the sea. Thompson was an Indiana pioneer who had represented his state in its legislature as early as 1834. He enjoys the distinction of being the first fresh-water Secretary of the Navy, since all his predecessors had come from the seaboard states. Robeson was a member of the new school of Republican politicians, and Thompson was originally an old-line Whig. Their reputations and political services had been for the most part confined to their respective states, although Thompson is credited with drafting the national Republican platform of 1876. Robeson was attorney-general of New Jersey when called to the headship of the Navy Department. He had never served in the national legislature. Possibly it was for this reason that he proved so impatient of legislative control. Thompson was a Whig member of the House from Indiana in 1841-1843 and 1847-1849.

It was generally understood that Robeson owed his appointment to the influence upon Grant of Senator A. G. Cattell, of New Jersey. Robeson was a young man, high-strung and of excellent stock. He was a "hale fellow well met," true as steel to his friends, and fond of good-living and the pomp of his position in the cabinet. In the Navy Department he was rather easy-going. He held the reins of administration too loosely, and had little aptitude for the details of the navy business. With an inborn desire to please he gave too ready an ear to his friends and the politicians of the capital. He had none of the qualities of a reformer, and was without the capacity to check departmental abuses. He, however, served the navy industriously and had its good at heart. He was much in advance of Congress in his efforts to increase and improve the fleet, and for this reason laid himself open to the charge of violating the law. His administration of the department was severely criticised, and he was made the subject of probably more cartoons than any other man of his time. He was reputed to be a "bad sailor," and they used to tell the story that the waving lines in the old carpet at the White House, presented by the Sultan of Turkey to the President, made him seasick. His knowledge of constitutional law suggested the *mot* attributed to Senator Matthew H. Carpenter that he was a "great constitutional lawyer among sailors, and a great sailor among constitutional lawyers." Hugh McCulloch wrote that the Secretary of the Navy was a "fine speaker and an able lawyer. Mr. Robeson was the most abused member of the cabinet, but the abuse to which he was subjected neither soured his temper nor injured his digestion. He was a hard worker, without being apt in business. If instead of being Secretary of the Navy, he had been Attorney-General, he would have won an enviable national reputation. Talented, genial, warm-hearted, he was and is a favorite wherever he is known."[95]

Secretary of the Navy Richard W. Thompson was somewhat old, slow-moving, conservative, and obedient to the strict and narrow interpretation of the law. He shared with his section of the Union its prejudices against the upbuilding of the navy and in favor of economy in naval expenditures. Since during Hayes's administration the navy in its decline touched its low-water mark,

[95] McCulloch, Men and Measures, 352.

it seems fitting that this shrewd and kindly old landsman should at this time have been called from his Hoosier home to preside over its destinies. The late Senator Hoar has left us in the following words an appreciative characterization of Thompson:

> I had great respect for him. He lived in the lifetime of every President of the United States, except Washington, and I believe saw every one of them, except Washington, unless it may be that he never saw Theodore Roosevelt. He was a very interesting character, a man of great common sense, public spirit, with a wonderful memory, and a rare fund of knowledge of the political history of the Northwest. Indeed he was an embodiment of the best quality of the people of the Ohio Territory, although born in Virginia. His great capacity was that of a politician. He made excellent stump speeches, managed political conventions with great shrewdness, and also with great integrity, and had great skill in constructing platforms. Colonel Thompson was a very valuable political adviser. It has never been the custom to select Secretaries of the Navy on account of any previously acquired knowledge of naval affairs, although the two heads of that Department appointed by Presidents McKinley and Roosevelt have conducted it with wonderful success in a very difficult time. A day or two after the inauguration, John Sherman, the new Secretary of the Treasury, gave a brilliant dinner party to the cabinet, at which I was a guest. The table was ornamented by a beautiful man-of-war made out of flowers. Just before the guests sat down to dinner a little adopted daughter of Secretary Sherman attached a pretty American flag to one of the masts. I asked Secretary Thompson across the table to which mast of a man-of-war the American flag should be attached. Thompson coughed and stammered a little, and said: "I think I shall refer the question to the Attorney-General."[98]

In managing the department neither Robeson nor Thompson were as forceful as Welles, and Borie was little more than a figure-head. The secretaries of Grant and Hayes failed to give the Navy Department the "executive touch." Under Welles, and especially during the Civil War, the influence of the navy on naval administration, relative to that of the secretariat, declined. During the war comparatively few naval officers were stationed in Washington. The masterful spirits were usually in command of vessels. With the ending of the war, and more particularly with the passing of Welles, the navy reasserted itself in the department. Under Borie it was all-powerful. Although checked under Robeson, it was still strong. The number of officers detailed to duty in the department was large. The chief of the Bureau of Navigation, who since 1865 had been also the head

[98] Hoar, Autobiography, II, 25-26.

of the Office of Detail, was an increasing power in naval administration. The head of this office occupies a strategic position in the Navy Department. He, with the consent of the Secretary of the Navy, moves and removes the officers and controls the naval ships. In the naval firmament he is a star of the first magnitude and rivals the Secretary in brilliancy. Until after the Spanish-American War, no other officer of the navy compared with him in power, authority and consequence. Since among the officers there is much rivalry to obtain good details of duty and to escape bad ones, they are likely to blame the head of the Office of Detail for their dissatisfaction over their orders. He is therefore both feared and hated, and the visits to his office are usually of an official character only. Since his duties were taken from those of the secretariat, the power and influence of the latter have greatly diminished. The Secretary of the Navy as a positive force in naval administration has in recent years greatly waned.

For seven years under Grant and Hayes the position of chief of the Bureau of Navigation was efficiently, and to the best of his ability impartially, filled by Rear-Admiral Daniel Ammen. From 1869 to 1871 Ammen had been chief of the Bureau of Yards and Docks. His successor in this latter position was Rear-Admiral C. R. P. Rodgers, who filled it until 1874. In 1871 John Lenthall was succeeded by Isaiah Hanscom as chief of the Bureau of Construction, who held this office until 1877. The chiefs of the Bureau of Steam Engineering during the years 1869-1881 were Engineers in Chief James W. King, W. W. W. Wood, and William H. Shock. Commodore William N. Jeffers presided over the Bureau of Ordnance from 1873 until 1881. The services of other chiefs of bureaus during this period were not especially notable. In 1876 Charles G. McCawley succeeded Jacob Zeilin as commandant of the marine corps.

During the administration of Grant and Hayes, but few changes were made in the organization of the Navy Department, and these were by way of the addition of new machinery. On the discontinuance of the judge-advocate general of the navy in 1870, his duties were vested in a naval solicitor, who was attached to the Department of Justice. This arrangement lasted for ten years. On June 8, 1880, a statute was passed authorizing the President to appoint for a term of four years a judge-advocate

general of the navy from the officers of the navy or marine corps." He was to have an office in the Navy Department, and was to receive the rank, pay and allowances of a captain of the navy or a colonel of the marine corps. His duties were to receive, revise and record the proceedings of all courts-martial, courts of enquiry and boards for the examination of officers for retirement and promotion. He was also to perform such other services as had been heretofore performed by the solicitor and naval judge-advocate. On June 8 President Hayes appointed Colonel William B. Remey, of the marine corps, to the new office, who served as Judge-Advocate General for twelve years.

In 1869 the chief signal office was organized and attached to the Bureau of Navigation. The principal duties of the chief signal officer of the navy were the preparation of signal books and codes and the instruction of young officers in signaling. In 1873 Secretary Robeson established in the same bureau the office of the superintendent of compasses, and gave it charge of the inspection and improvement of compasses and the determination of their deviation and variation. In 1870 or 1871 the board of inspection was organized to inspect the various vessels of the navy and to make reports upon their condition. In 1871 the board for the examination of officers for promotion and the board for the examination of officers for retirement, which had been organized by Secretary Welles, were consolidated.

In 1877 Professor Simon Newcomb, U. S. N., became superintendent of the Nautical Almanac Office, which since 1866 had been located in Washington, and for 20 years he filled this position with great ability and distinction. In his "Reminiscences of an Astronomer," Newcomb gives a most interesting account of the work and personnel of his office. On assuming his duties in 1877, he obtained more commodious quarters for the office, reduced the prices paid for computations, and removed two employees for inefficiency. One of these latter was a proof-reader, who occupied a high position in the Grand Army of the Republic and was "excellent in every respect except that of ability to perform his duty." Some of the most difficult and recondite of the mathematical studies of the office were made by Mr. George W. Hill, "who will easily rank as the greatest

"U. S. Statutes at Large, XXI, 164.

master of mathematical astronomy during the last quarter of the nineteenth century." Newcomb says that he never worked harder with a superior than he did "with Hon. R. W. Thompson, Secretary of the Navy, about 1880, to induce him to raise Mr. Hill's salary from $1200 to $1400. It goes without saying that Mr. Hill took even less interest in the matter than I did. He did not work for pay, but for the love of science. His little farm at Nyack Turnpike sufficed for his home, and supplied him necessities so long as he lived there, and all he asked in Washington was the means of going on with his work."[88]

On March 15, 1877, Secretary Thompson organized a board, consisting of the chiefs of the several bureaus of the department to reform the business of the bureaus and to correlate their work. The creation of this board is quite significant. For many years the Navy Department had developed by differentiating its functions. An attempt was now made by Thompson to unify its parts. The new board was to meet twice a week, and was to be presided over by the Secretary of the Navy. At its meetings the chiefs were to lay before it statements of the business of their bureaus, which were to be open for discussion. The board was also to consider the employment of men in the navy-yards. The new organization effected little, for the centrifugal forces of the department were too much for it.[89]

Throughout the period 1869-1881 attempts were made in Congress to create a permanent board of naval officers that should occupy a position in the administrative hierarchy between the chiefs of bureaus and the Secretary of the Navy. A considerable agitation for the creation of such a board was conducted in and out of the navy and the department. It is recollected that there was a similar agitation under Secretary Welles. The duties of the proposed board were not always clearly defined. It was to advise the Secretary of the Navy in professional matters, and especially in respect to the building, furnishing and equipping of the fleet. It was to review the action of the bureaus, and was to "harmonize and concentrate" their work. The line officers of the higher ranks, especially Farragut, Porter and Rowan, were chiefly interested in the project. Farragut thought that the

[88] Newcomb, Reminiscences, 214-233.
[89] General Orders and Circulars 1863 to 1887, p. 156.

board should be called the "Board of Admiralty," and should be composed of officers not below the grade of rear-admiral. Various bills were introduced in Congress embodying the views of the friends of the proposed organization. But whether it was called a board of admiralty, board of navy commissioners, board of survey, or board of assistants, it proved equally distasteful to the majority of the members of Congress. One measure, however, passed the Senate, but failed in the House. This was the famous Grimes Bill, which caused great commotion in the navy and the department in 1869. Secretary Robeson recognized that there was need of a board to correlate the action of the bureaus, but thought that it should be "wholly advisory, and without the power of interfering with the action of the Executive or his responsible representative." Secretary Thompson insisted that, if a board were created, it should be entirely responsible to himself. The secretaries did not favor the establishment of an organization that would encroach upon their powers. The staff officers were opposed to the proposed measures, since they regarded them as drawn in the interest of the line officers, who, they thought, were attempting to seize the reins of control in the department.[100]

It may be worth while to speculate upon the effects on the organization of the Navy Department of such a navy board as that contemplated by Farragut. Had it been established in 1869, it would in all probability have acquired by this time a position of commanding influence in the work of the department, if not one of dominant control. Composed of officers of the highest rank, and occupying a strategic position, it could hardly have been confined to the exercise of wholly advisory powers. Under the laws of departmental growth and of administrative absorption and accretion of powers, it must have gradually increased its duties and authority. The actual powers of the Secretary of the Navy would have been diminished, and the influence of the navy and especially of its chief officers in the department would have been augmented. The bureau chiefs could not have held their own against the new organization. The ear of the Secretary of

[100] Ann. Rept. of Sec. of N., 1869, 24-25; Congressional Globe, 1869-1870, p. 5329; Congressional Record, III, 217; IV, 2861, 3761; VII, 4467; House Miscl. Doc., 41 Cong., 2 sess., No. 33; House Ex. Doc., 41 Cong., 2 sess., No. 171; House Miscl. Doc., 44 Cong., 1 sess., No. 170, pt. 8, answers to circular letter.

the Navy must have gradually become inaccessible to all advice emanating from officers outside of the board. The department would have doubtless received what it has for a long time needed, a correlation and unification of its parts, and a larger element of permanence, continuity and technical knowledge at its apex.

During the period 1869-1881 the number of officers on duty in Washington increased rapidly. In January, 1869, the number of line officers of the active list employed at the capital was about 15. Fifteen years later, in January, 1884, this number had increased to 102; at the same time the staff officers in Washington numbered 59. These officers were employed at the Navy Department, Washington navy-yard, Hydrographic Office, Naval Observatory and "on special duty in Washington." The civil employees of the Navy Department at the capital also steadily increased. The Blue Books show that their number, exclusive of the employees at the Washington navy-yard, was 111 in 1869, and 222 in 1881—or exactly twice as many. The number of clerks increased during this period from 57 to 109. The number of regular employees of the eight bureaus changed but little. The increases occurred chiefly in the Secretary's office and the Hydrographic Office, and in the force of caretakers of the Navy Department building. The actual growth of the work of the department during 1869-1881 did not keep pace with the augmentation of the department's personnel.[101]

During the administration of Hayes the Navy Department occupied its new quarters, situated in the State, War and Navy Building in Washington, near the White House, on Pennsylvania avenue. This large structure is located on the site and grounds of the old buildings of the War and Navy Departments. It is a huge towering pile of granite, and is said to be honestly admired by the populace, but condemned by the architectural critics. It was designed by Mr. A. B. Mullett, when supervising architect of the treasury. Its style is that of the Italian Renaissance. Its four façades, which are substantially alike, surround a court, which is divided by a "center wing." The State Department building or south wing was first built, being commenced in 1871. The last wings were completed in 1888, when the whole building

[101] Navy Register, 1869 to 1881; Official Register of U. S., 1869 to 1881; House Ex. Doc., 48 Cong., 1 sess., No. 125, 19-21; Sen. Ex. Doc., 47 Cong., 1 sess., No. 17.

was for the most part finished. It covers four and one-half acres, contains two miles of corridors, and cost about $11,000,000.

The Navy Department occupies the east wing which faces the White House. On June 10, 1872, Congress appropriated $400,000 to begin the construction of this wing, which was shortly commenced under the direction of the supervising architect of the treasury. After the expenditure of $923,000, it was stopped. On March 3, 1875, Congress placed the undertaking under the charge of the Secretary of War, and the work was resumed under the direction of a member of the engineer corps of the army. With the exception of the library of the department, the east wing was completed in the spring of 1879, and a year later the library was turned over to the Secretary of the Navy. The total cost of the east wing was $2,672,287. The only wood used was for the doors, floors, and interior furnishings. All other parts were constructed of stone, brick, concrete, plaster, iron, copper and glass. The length of the east wing is 341 feet, depth at the curtains 62 feet, and height from sidewalk 135 feet. The total number of rooms of all sorts is 173. There are seven floors—sub-basement, basement, first, second, third and fourth stories, and "cockloft." Two elevators afford easy communication. The library is finished and ceiled entirely in iron, and in a most artistic manner. The walls are of iron, inlaid with 32 marble panels. The green marble used in the construction of the panels is malachite, from the Alps; the yellow, sienna, from Italy; and the red, porphyry, from France. The conglomerate is from Lake Champlain. The floor is inlaid with Minton tiling. There are allegorical figures in the corners of the room representing "War and Peace," "Liberty," "Industry and Mechanics," "Literature, Arts and Commerce."[102]

The east wing was occupied by the Navy Department during 1878-1880. The Bureau of Steam Engineering was the first and the naval library the last to move to the new quarters. It was decided that the Navy Department should temporarily share its building with the War Department. On the afternoon of April 16, 1879, Thomas Lincoln Casey, lieutenant-colonel of the corps of engineers of the army, formally turned over the east wing to the Secretary of the Navy and the Secretary of the War, and

[102] Ann. Rept. of Sec. of War, 1876, p. 366; 1878, pp. 477-484; 1879, pp. 449-459; 1880, pp. 567-568; Description of Library for Visitors.

deposited its keys with them. Casey furnished the Secretary of the Navy with twelve drawings and an explanatory memoir setting forth the arrangements respecting the supplies of water and gas, systems of heating and ventilation, telegraph service and sewerage. A brief notice of the transfer of the building to the departments was given by the *Washington Star* of April 17, 1879:

> Shortly after three o'clock yesterday afternoon Colonel Casey, superintendent of public buildings and grounds, conducted Secretaries Thompson and McCrary, and Chief Clerks Hogg and Crosby through the new wing of the new State, War and Navy Department building, and formally turned that portion of the building over to them. The two Secretaries were much pleased with the new quarters they are to occupy, which are much more commodious and by far more elegant than those they now have. Secretary Thompson says that perhaps his new room is a little too elegant and luxurious.[103]

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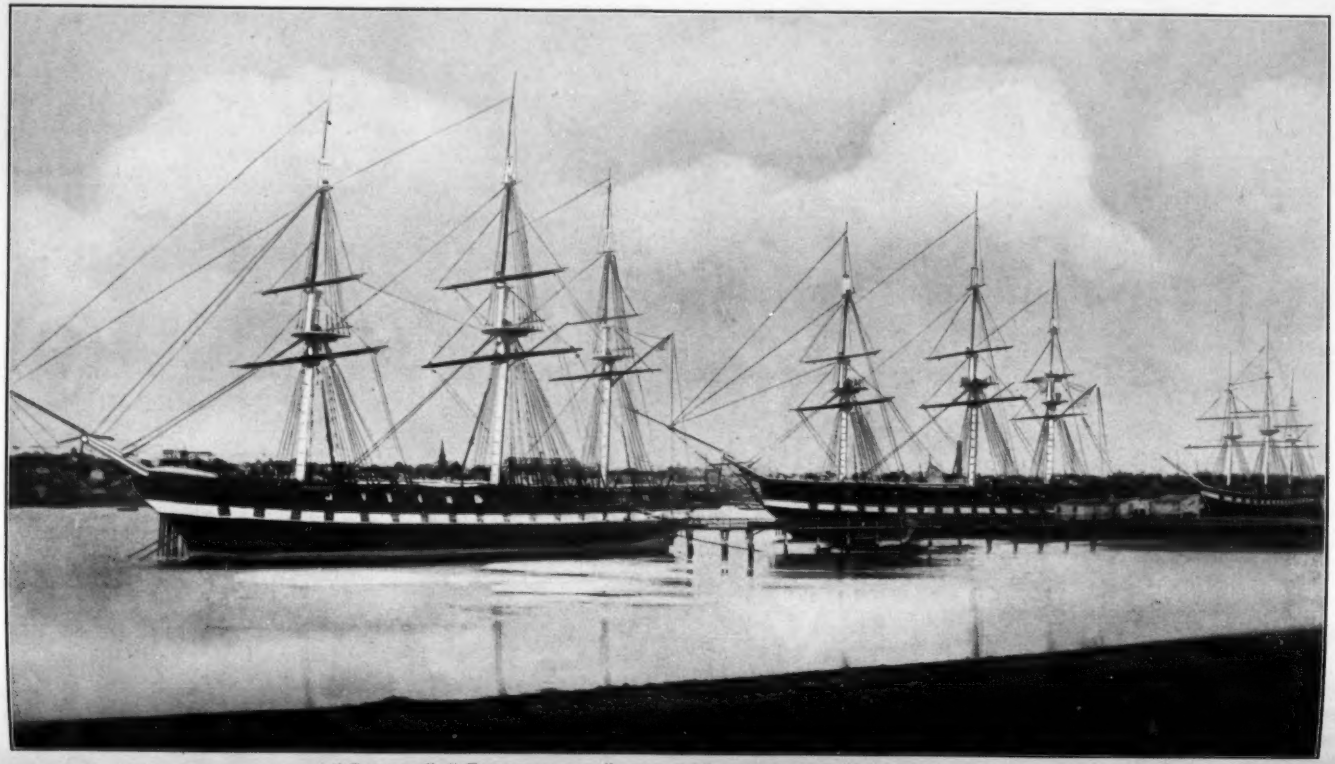
[103] *Washington Star,* April 17, 1879.



"SANTEE," "CONSTITUTION," AND "MACEDONIAN," NEWPORT, 1864.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE *SANTEE*: AN APPRECIATION.

By CARROLL STORRS ALDEN, PH. D.

It would be unseemly if a national ship that has attained the venerable age of 93 should end her career without some recognition of her long and faithful service.

The *Santee* has ever been unique. No other ship has been more abused and ridiculed, and yet none has been more faithful in the performance of the humble duty required of her. While few ships have served so long, no other has the Department been able to hold with such absolute continuity at her station. Further, what are the three years required for the building of the modern battleship in comparison with the 35 years that elapsed between the laying of the keel and the launching of this old frigate, followed by six additional years before she was ready for her first cruise? According to a Naval Academy ditty of the late '90's, the midshipmen boasted of her as their fastest ship:

"That is the *Santee* prison ship
On which we take our yearly trip;
She is the fastest thing around."
"How can that be?"
"She's fast aground."

But as the poet had not gone to the bottom of things, making sure his premises, his conclusion cannot be recognized and this claim to distinction should be abandoned. Strangely enough, while no craft has been more furiously execrated by midshipmen, none other has been such an unfailing inspiration to budding poets. This old frigate, in contrast with the many that are linked together as sister ships, had no connections and has ever been a lonely, solitary figure. She never had her like and now she is about to disappear. Shall it be without a memorial?

Though so strictly Northern in all her early associations, she was named after the Santee River of South Carolina. Her keel was

laid at Portsmouth, New Hampshire, in 1820. Emmons, in his *History of the Navy*, 1850, lists her as a 44-gun frigate, designed to carry 50 guns with a complement of 480 men, but for excellent reasons gives no statistics as to her launching and cost. Still five years were to pass before she was to glide off the stocks, and of her cost probably no accurate figures were to be had. According to report, "She was a political ship, built piecemeal about election time for many years by prospective voters who had to be taken care of."

In 1853 Secretary of the Navy Dobbin called the attention of Congress to the weakness of our navy. There was urgent need of more ships. It was when Perry had delivered his message to the Mikado of Japan and was about to return and demand a treaty. The annexation of Hawaii was being considered. There was a spirited controversy with England over the neutrality of Nicaragua. Trouble was brewing with Spain as to Cuba, and Soulé, the American minister at Madrid, was doing his utmost to secure the acquisition of the island by the United States, although he saw, as did others, that war might be the consequence. Under these conditions Secretary Dobbin succeeded in persuading Congress to authorize not only the construction of six first-class steam frigates, but also the completion of the long-waiting sailing frigate; thus it was that the famous *Hartford, Merrimac, Wabash,* and *Santee* came into being, ready to play their historic rôles in the Civil War.

Two years later, 1855, the *Santee* was launched. Had the frigate not been long schooled in the art of patient waiting, she might have straightway complained that her state was no whit better after launching than before. As her name appears on the successive *Navy Registers,* though she was no longer "on the stocks," she was "in ordinary," and remained so until the beginning of the Civil War.

It was at 8 p. m., June 8, 1861, that the crew were received on board and the U. S. S. *Santee* was put in commission. Next morning the crew were mustered and at nine o'clock the colors were hoisted with the pennant of Captain Henry Eagle. Forty-one years after her keel had been laid! It was like making one's debut in middle years, dangerously near old age. How could a ship be expected to behave properly with such an abnormal beginning and no youth at all! However, if her ways were rather old-fashioned, the first writers of her log, with loyalty and good breeding, take

no notice of the fact. Besides, it must be remembered that 1861-5 was a period when the United States Navy abounded with eccentric characters, some of them fairly grotesque. History has nothing else to equal that strange collection, to meet the sudden requirements increased to 15 times what had been the normal size of the navy, in which were to be found private yachts, ferry boats, merchantmen of every kind, and cheese-box monitors. In contrast with these improvised warriors, the *Santee* was a sedate and highly conventional old lady.

If the frigate was somewhat human, on June 20, 1861, her gentle, maidenly heart must have been in a good deal of a flutter, for she was now to enter upon her career; that evening she set out on her first voyage, sailing south to join the Gulf Blockading Squadron. To quote from the log: "At five called all hands and made sail to top sails and top-gallant sails on starboard tack. Sprung the ship by a hawser on starboard quarter, and at five cast off in charge of pilot and stood down the river, the forces at Fort Constitution cheering us as we passed, which was returned. At six discharged the pilot, made all sail. At sunset inspected the crew at quarters, secured and shotted all the broadside guns ready for sea."

On June 29 the log has the mournful entry, "Adam Miller died in the mizzen top whilst reefing topsail from apoplexy." But otherwise the voyage seems to have been without misfortune.

A rapid glance over the log shows her making one, three, five, or seven knots an hour. Under unusually favorable conditions she attained a speed of ten knots, but her average on this, her only cruise was not more than five or six—not especially fast for the '50's or '60's when sailing ships had reached such a high degree of perfection. But perhaps it is in our ignorance that we have spoken. For on referring to a statement made to the Department by Captain Eagle on her "sailing and other qualities," we find the following:

"How she sails close hauled in a top-gallant breeze? She has old-fashioned trusses, and will not lay closer than 6½ points. In smooth water she went 10½ knots. In a top-sail breeze? In smooth water, 6½ points from the wind, 8 knots."

"How she sails and steers with the wind abeam, under royals? Remarkably well. Under top-gallant sails? Do. Under top sails? Do."

He gives her best trim for sailing as 19 feet 6 inches forward and 22 feet aft, with 50 tons as the necessary ballast. Further, "She stows six months provisions very well and carries 41,560 gallons of water."

According to orders Captain Eagle on his way south ran into Hampton Roads to receive a supply of shells from Washington. Leaving that place on July 10 he sailed for the west coast of Florida, where he joined the Blockading Squadron under Flag-Officer Mervine.

On August 8, 1861, the *Santee* had a taste of real war. At least she made a prize. It was when she was sailing off the southern extremity of Florida that she sighted a suspicious-looking schooner, too near to escape without scrutiny. A boarding party from the *Santee* led by Lieutenant James E. Jouett found that she was the American-built schooner *C. P. Knapp,* sailing under British colors, bound from Brashear, Louisiana, to Havana. There was considerable irregularity in her papers and her change of nationality seemed illegal. Under the circumstances Eagle decided to tow her to Pensacola and submit the case to his senior officer. Eventually the schooner was restored, but the *Santee* had shown her teeth and experienced the first thrill on the realization of power.

Six days later we find another record of the *Santee:* Flag-Officer Mervine directs that she remain at her anchorage off Fort Pickens, near Pensacola, until further orders. For the next month she was there or at Key West, and then was sent to the station off Galveston, where she took the place of the U. S. S. *South Carolina,* Commander Alden. It was dreary, monotonous duty that was the lot of any ship on the Texas blockade, and it is evident that the *Santee* was to be properly prepared, for she received from the *South Carolina* 23,000 pounds of bread, 75 barrels of salt provisions, and 25 barrels of whiskey.

At Galveston she anchored just off the bar, and on the 27th of October she made a second capture. It was the hermaphrodite brig *Delta,* again American-built and sailing under British colors; she had come from Liverpool and was attempting to slip into Galveston with a load of salt. In this case there was no senior officer to refer the matter to. The brig was sent to the prize court at New York, where she was condemned. On December 30 the frigate had a similar piece of luck. The lookout reported a small schooner on the horizon to the south. Boats were sent in

pursuit and after pulling five or six miles captured her. She proved to be the Confederate schooner *Garonne*, of 14 tons, loaded with 165 bales of tobacco, bound from New Orleans to Brownsville. The tobacco was retained to be issued to officers and crew, the paymaster taking it at invoice price. The schooner was sent to New York, where she was condemned.

The action recorded in history as the most heroic in the *Santee's* career was that of the 7th of November, 1861, when the schooner *Royal Yacht* was taken and set fire to. Lieutenant James E. Jouett had volunteered to take two launches, enter the harbor, and capture a large armed schooner that had nightly been appearing near the entrance as if waiting the chance to slip out; also, if conditions were favorable, he planned to destroy the war-steamer *General Rusk*, lying at her wharf. The first launch under Lieutenant Jouett and the second under Lieutenant Mitchell left the *Santee* at 11.40 p. m.; rowing into the harbor they succeeded in passing the schooner and the two forts, but in avoiding the sentinels on one side grounded on the other and were discovered. Since the steamer could be taken only by surprise, Jouett now determined to return to the *Royal Yacht* and board her.

When the launches were still some distance away they were hailed, but they dashed forward. Just as the first launch ran alongside, Carter, the gunner, fired the launch's 12-pound howitzer and leaped on the schooner's deck. The shell crashed through the schooner's side at the water line, but the recoil of the gun pushed off the launch. It was brought back again by a strong effort, and Jouett was the next to board the schooner. He received a dangerous thrust from a sword bayonet in his arm and side, but he knocked down his assailant and pressed forward to the aid of Carter, who all this time had been fighting without support. According to E. S. Maclay, who had the narrative direct from Jouett, the mêlée became so desperate that twice the men tumbled back into the launches and were on the point of retreat, but returned to the fight when they discovered they had left their leader behind. Several of the Confederates were killed, before thirteen others of their number had been overpowered. On the Union side, besides the wounding of Lieutenant Jouett and Carter the gunner, one seaman was killed and six others were wounded—one so seriously that he died shortly afterwards. The boarders

spiked the *Yacht's* 32-pounder, seized her colors, and after removing the prisoners, set fire to her.

In appreciation of the gallantry of Jouett and his men, Flag-Officer McKean issued a general order "to be read on the quarter-deck of every ship attached to the Gulf Squadron." And this was followed by a letter of the highest commendation from the Secretary of the Navy, Gideon Welles. The latter concluded his letter with an order "detaching Lieutenant James E. Jouett from the *Santee* and directing him to proceed to New York, as it is the purpose of the Department to give him a command worthy of his gallantry."

Early in the spring of 1862 (March 21) Secretary Welles ordered the *Santee* to Vera Cruz to relieve the *Potomac*. But her stay there could hardly have been more than a month, for on May 1 Eagle is directed to report to Farragut, and, shortly after, the *Santee* was back on blockade duty off Galveston. Eagle then began to take aggressive measures. Knowing that the sending home of his ship was imminent, he demanded the surrender of Galveston, and even notified the foreign consuls that the bombardment of the city would commence at his earliest convenience after a certain date (May 23). However, as the gunboats and mortars which he had asked from Farragut for the project were not to be had, he gave up the attempt.

Enlistments in the crew—for one year—were beginning to expire, and the men were seriously affected by scurvy. The last of July, Eagle was directed to leave all stores and ordnance not necessary to take the ship to Boston, and on the first of August the log records, "All hands called at one. Up anchor. Sail made." Soon the *Santee* was on her way north, reaching Boston on the 23d of August.

With this the war record of the *Santee* ends. The introduction of steam as motive power had made her type obsolete, and at least one radical defect in her construction prevented her from being among the few sailing ships still retained for active duty. The fault lay in the arrangement of the gunports; these were placed, the upper row directly above the lower, instead of at half spaces between. As a result the vertical strain, on firing gun-deck and spar-deck guns simultaneously, was not distributed, and there was danger that a series of heavy broadsides might tear the ship to pieces.

But how inglorious the modern world must be judged if praise for service is due merely to those who join in battle. The usefulness of the *Santee* had only just begun. Early in October, 1862, she left Boston for Newport, where together with the famous old *Constitution* she was to afford temporary schoolrooms and quarters for the Naval Academy. Thus she entered upon the second phase of her career, and it is in this that she has been so thoroughly unique. Henceforth her fortunes were linked with those of the Naval Academy. For the fifty years that were to follow, her decks were trod by midshipmen. She went with them at the

GUN DECK, "SANTEE," 1892.

close of the war back to Annapolis, and never once, so far as the writer can learn, was the ship absent from the Academy for dry-docking, overhauling, or any other purpose.

Lieut. Commander Robert L. Phythian, later Superintendent of the Naval Academy, was the first to have command of her at Newport. Another officer, associated with her at this time and mentioned in the *Naval Academy Register* of 1862, was Lieutenant William T. Sampson, "Assistant to Commandant of Midshipmen, attached to School Ship *Santee*."

The midshipmen at Newport, their thoughts full of the recent exploits of Farragut, Foote, Walke, Davis, and a score of younger officers, must have felt that in the rigors of school life they were not

far removed from the hardships of actual war. They slept in hammocks, and though the hammocks were not any too comfortable for one unused to them, what an agony at six a. m., when all was cold and dark, to hear the drums, the signal for rising. They lashed their hammocks, and then in spite of wintry blasts were sent aloft over the mastheads and down again, merely as an appetizer. "Nothing could have been more desolate," says Park Benjamin, "than the outlook to the Plebe whose first experience brought him on these schoolships. During the day, he sat and studied at one of the desks, long rows of which extended up and down the gun-deck, and occasionally marched ashore to the windy recitation-rooms, where he contracted bad colds along with a knowledge of arithmetic. The commissary department was always more or less out of gear, and the meals eaten in the blackness of the berth-deck by the light of a few ill-smelling oil lamps were wretched."

During the summer of 1865 the Academy was moved back to Annapolis, and on August 2 the *Santee* came to her mooring near Fort Severn, so long to be hers. At Annapolis for the next four years her duty, like that of the *Constitution*, was to be much the same as at Newport. The Academy Yard, which during the war had been used as a military hospital, presented a scene of chaos. "New Quarters" was soon begun, but until its completion in 1869 the ships were necessary for the housing of the midshipmen.

The *Santee's* log during these years passes over many incidents that would be of interest to us, but contains enough to repay reading. On November 12, 1865, the entry notes: "Midshipmen attended Divine Service on board"; and similar entries will be found throughout the year. On January 1, following, two items suggest that the New Year was ushered in with punctiliousness and enthusiasm: "Served out clean hammocks to midshipmen. . . . Squares of glass broken by Midshipman N—n, 4. Do. Midshipman T—r, 5. Do. Midshipman L—r, 5. Total broken, 14." On the 4th of February, 1866, the log records: "Admiral Porter accompanied by Generals Grant and Sherman visited this ship." On the 9th of February: "The midshipmen of the 1st, 2d, 3d, and 4th Divisions drilled at the great guns."

This last entry suggests one of the ship's special uses. Beginning with 1866 she is mentioned in the *Naval Academy Register* no longer as the school-ship but as the "Gunnery Ship *Santee*";

at about this time the parapet of Fort Severn, which in earlier years had been used for gun drills, was stripped of its cannon, roofed over and made into a gymnasium. The *Santee* was moored so that her starboard broadside bore on Greenbury Point, and although the ship never left her wharf the midshipmen were given target practice on her. Admiral John Schouler, who was on duty at the Academy during the '70's, tells of an incident that occurred during one of the afternoon drills. A midshipman's shot ricochetted and, swerving to the right, struck an oyster boat amidships, as they learned later, directly beneath the board commonly used for assorting the oysters, on which was stretched a negro. The young officer, conducting the drill, with his glass saw the shot strike and a man leap high in the air and fall in a heap on the deck; whereupon the boat immediately put about and made for the harbor on the other tack. The officer was in an agony of mind. A haunting picture of the tragedy of blood on the bugeye rose before him. Dismissing the gun division he hastened to the City Wharf, which the oyster boat was approaching. It happened, however, that very little damage had been done; and the skipper of the little craft, instead of charging him with manslaughter, expressed only a gleeful satisfaction on having witnessed his "lazy nigger" for once in his life make a little haste.

Another bit of her history, much more serious in character, is related by Admiral C. C. Todd, who modestly prefaces the story, "According to the best of my recollections." Shortly after her return from Newport some of the midshipmen who, for breaches of discipline, had been placed in confinement on the *Santee* tired of the Naval Academy and of the old frigate in particular. To pass the time and afford some novelty they formed a plot to scuttle her, and actually set out to carry it into execution. Discovery followed and the ship was saved. On inquiry, eight men belonging to all three classes at the Academy were found to be implicated. A court martial was ordered, whose members were not officers attached to the school but stern disciplinarians fresh from war. They looked upon the midshipmen's act not as a boyish prank but as a criminal offense. To scuttle a ship was in their judgment worse even than to set fire to her, and all who attended the sessions of the court came to feel the same. The solemnity of the proceedings made a great impression on the midshipmen. At their conclusion the court found five of the eight midshipmen guilty.

These were punished not only by losing their place in the Academy but by being held for service in the navy among the enlisted men; they were reduced to the grade of "third class boys," which was lower than that of seamen, in fact the very bottom.

Following the completion of New Quarters, the *Constitution* was taken away from Annapolis and the *Santee* was used as the station ship; gun drills were continued, and the entering fourth class before being merged into the brigade in the spring and late summer swung their hammocks here, as also did recalcitrant midshipmen at almost all times during the year. Thus in the fall of 1881, when Admiral Rodgers, on his second tour of duty as Superintendent, discovered hazing of a rough nature, he sent 48 men in a body to the *Santee*, and in addition ordered a court martial. The dragnet was so extensive in its operation that the entire brigade became alarmed and pledged themselves not to transgress again. Trouble harder to cope with came a year and a half later during Captain Ramsay's administration. There appearing a general spirit of insubordination when a cadet petty officer was disrated because of misconduct in examination, the entire first class were immediately marched to the "prison ship" and quartered there. Considerable tension ensued. Cadet officers resigned; their resignations were not accepted; instead 21 of the 25 were reduced to the ranks and placed in confinement on the old frigate. All amusements stopped and a doleful time followed, terminated by the most somber graduation day known in the history of the Academy.

In the less exciting days of this period the part the ship played is described in midshipman verse:

THE *SANTEE*.

[*Fag Ends*, 1878.]

The shades of eve were falling fast,
When through the yard a middy passed,
With bag in hand and looks so glum,
That few could hear his lonely hum,
"*Santee*."

"Oh come and play," his classmates cried,
"Upon the field. Don't be a snide."
Down hung his head, and a red glow
Suffused his cheeks—he answered low,
"*Santee*."

The maiden, in her Sunday best,
Beseeching cries like all the rest,
"My spoon, desist." She weeps, he sighs,
And blubb'ring, in wild accents cries,
"*Santee.*"

The old man at the garden gate
Tries hard to turn our middy's fate.
"Come back and pay me what you owe."
But middy only says, "No go!"
"*Santee.*"

"Let me throw off this awful yoke;
Must I give up my cheering smoke?
Must I be 'fumed' to 'scape the end
To which all other smokers tend?"
"*Santee.*"

"Must I give up the fragrant weed,
And of good comfort feel the need?
Or pace the deck firm as a rock,
Upon the ship down at the dock?"
"*Santee.*"

"Go, tell the winds to spread it o'er
All distant lands, from shore to shore.
I cannot stop, so why debate?
I can't escape that awful fate."
"*Santee.*"

OH, *SANTEE.*

[*Fag Ends*, 1881.]

Oh, noble mass of wood, and guns, and ropes, and sails,
Poetic remnant, left by well-met gales,

* * * *

No more thy ancient smooth-bore guns will make the welkin ring,
Except when we, on Saturdays, with closed ears and eyes,
Manipulate thy battery at great-gun exercise;
Thy pure white decks, so broad and fair, which knew the warriors tread,
Are now by divers other warriors paced along instead,
Who, lonely, stand their watch from 10 to 12 p. m. . . . .

The '80's were marked by a great literary efflorescence among the midshipmen, or "cadets" as they were then called; budding poets were without number, and no subject was used more commonly than the *Santee*. Either the hours of peaceful meditation were particularly favorable to the muse, or the poets were the ones who

especially got in trouble. We must believe that only a small part of the effusions have escaped the ravages of time, but such as we have constitute a fairly complete history of the Academy during this period, and are far too voluminous to print in a single article. They include "Down by the Old Sea-Wall," "Farewell to Chain Gang," "Hazer's Lament," and many others. We quote in this article from only a few particularly graphic.

PLEBE'S FIRST NIGHT ON *SANTEE*.

[*Junk*, 1889.]

We all turn in at nine o'clock
When the gugong gives the tap,
But that night's rest is doomed to be
An interrupted nap.

You no sooner get to dozing
And on Morpheus get a mash
When some one cuts your foot-rope
And down you come "kersmash."

You look about you quickly,
And in the distance see
A naked figure laughing
With undiminished glee.

* * * *

THE *SANTEE*.

[*Junk*, 1889.]

* * * *

The roaches and the bed bugs
Do rule this mighty craft,
They hold high carnival on both decks,
And sweep them fore and aft.

They run into the middies' desks
And calmly raise a row,
They'll lick the postage off your stamps,
And make an awful slough.

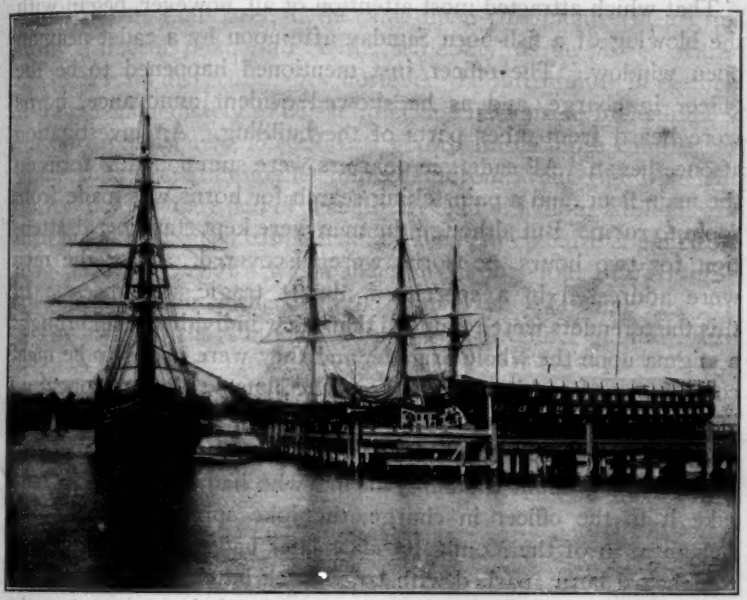
And 'mid the darkness of the night
You see their eyes a-gleaming;
Your nerves do pitch and toss within,
You feel so much like screaming.

* * * *

In the morning when the sunbeams
  Reach your poor devoted head,
You hear the sound of dripping,
  And "D—n this water in my bed."

The people on the decks above,
  Do holystone them down,
And little do they think at all
  Of those below who drown.

* * * *



"ESSEX," CONSTELLATION," AND "SANTEE," 1892.

Conspicuous among those who in the '80's sent cadets to the *Santee* was a certain officer in the Discipline Department who was in a highly nervous condition and who seems to have had little understanding of student life. Consequently there was no limit to the small pranks which the cadets played for his benefit, and which he regarded with painful seriousness. They understood him as little as he did them, or they could never have tormented him as they did. Various were the happenings in that part of quarters above which the stairs leading to the several floors circled. One night "Bismarck," a marine on watch below, was startled by some

one's letting fall a giant firecracker, with the result, according to the cadet poet,

> All the Supe's officers and Commandant's men,
> Couldn't make Bismarck stand there again.

Another time a bottle of concentrated ammonia was thrown; and again a cat, very much alive, was suspended from a string, which, if it didn't actually claw the head of the marine, at least came very near doing so.

That which attracted most attention of all, however, began with the blowing of a fish-horn Sunday afternoon by a cadet near an open window. The officer just mentioned happened to be the officer in charge, and as he showed evident annoyance, horns were heard from other parts of the building. An investigation at once began. All cadets in quarters were summoned to form on the main floor, and a painstaking search for horns was made from room to room. But although the men were kept standing at attention for two hours, no horns were discovered. Later the men were addressed in a speech of almost tragic seriousness. In this the offenders were reminded that a few individuals had brought a stigma upon the whole brigade, and they were urged to be men, come forward and bear the *onus* of the blame. To this appeal no one responded. The use of the unfamiliar Latin word, however, must have strongly impressed the hearers, for when some wag began talking about the *onus,* asking who had it and who would take it to the officer in charge, the joke spread like wild-fire. Certain men of the Youngster class later had made an enormous pasteboard horn, marked with large black letters, *ONUS.* After being photographed with it, they smuggled it into quarters. At an appropriate time this was lowered from an upper "deck" for the benefit of the officer. Those in the conspiracy escaped discovery, and the *Santee* was lonely, but not for long. Six days following the fish-horn affair, the nervous officer being again on duty, some of the congenial spirits of the Youngster class devised, for lack of other amusement, on release from rooms before taps, to pretend they had some dark plot in the yard. First one man went to the door of the officer in charge, looked furtively in and then slunk out of the main entrance near by. Another followed with like stealth. Then another, and another. The officer in charge apparently took no notice of their going. Thus they had

their little foolishness outside, which was nothing at all; but on returning they were all challenged and lined up in the lower hall. There were 24 gathered in this net of suspicious characters. In spite of the hour they were directed to pack their bags and go to the *Santee*. From their number this select band of heroes called themselves the "Tony Twenty-four." It was the Tony Twenty-four, after their short stay on the *Santee*, that arranged for the construction of the *Onus* and were photographed with it. They thought it would be particularly annoying to the victim of their pranks, some time later, if he came upon this picture in a great many different rooms, all on the same day, as he peered within the lockers on inspection. As, however, the full number of pictures were not immediately to be had, but one man made his exhibit at the appointed time. The officer's glance was at once caught, but the results were altogether different from what the wise and crafty Twenty-four had expected. Instead of looking anxious and distressed, he seemed calmed and pleased; the picture supplied his long-felt want. And it was a sheepish Twenty-four that straightway changed their residence to the *Santee*.

The story of the *Onus* is told in *Junk*, the cadet publication of 1889, as follows:

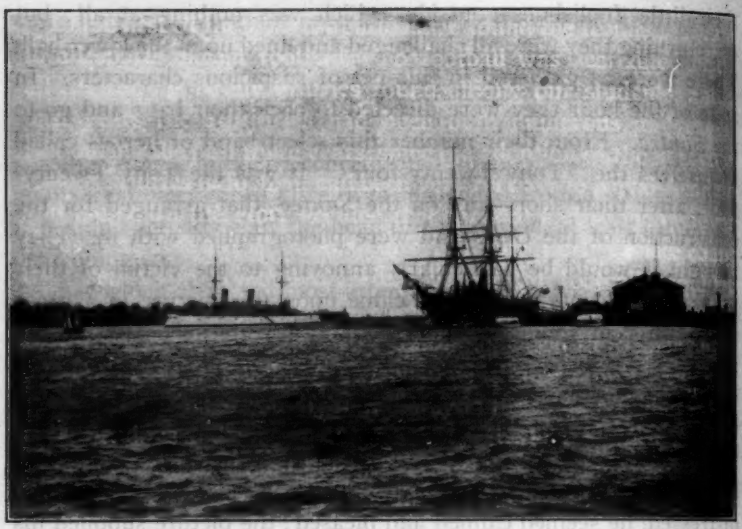
On Sunday afternoon it was,
And Dingenbills was on,
When there came from off the second floor,
The sound of a tooting horn.

Up rose the mighty Dingenbills,
And to the gyrene shout:
"Arise, awake, take up thy belt,
We'll turn the rascals out."

Then rushed he to the whistle near—
In whispers sweet and low—
Like fire the fearful orders spread,
"Send all cadets below."

"Fall in, fall in," he loudly cried,
"And I will keep you here
Until the culprit doth step forth,
And doth the 'onus' bear."

"And now you officer-of-the-day,
Go search the upper floor,
Upset the wardrobes and the beds
Into the corridor."



"OLYMPIA," "HARTFORD," AND "SANTEE," 1910.

THE SUNKEN "SANTEE," AND THE COLLAPSE OF THE SANTEE WHARF.
The stern of her successor, the *Reina Mercedes*, at the new wharf appears to the right.—January, 1913.

They searched the wardrobes thro' and thro',
  Turned beds all upside down,
Alas! alas! with all their pains
  No "onus" could be foun'.

As for the fellows in the hall,
  They rapidly grew lame,
Curses went up and men went down,
  But still no "onus" came.

The fellows tired and sleepy got,
  Their heads began to nod;
Then came the doctor on the scene,
  And mustered the sick squad.

The wardrobes were turned inside out,
  The bed clothes all upset.
A gun was snagged, a pipe, a plug,
  But still no "onus" yet.

Old Dingenbills then laid aloft;
  "I snagged all this and this"—
Thus spake the officer of the day—
  "The 'onus' still I miss."

Then spake old Dingenbills aloud,
  In tones both sad and low,
"Alas! I've missed my 'onus' dear—
  Let the battalion go."

MORAL.

When loud a fish-horn you do blow,
  Blow it out both far and wide—
Then skip—but first be always sure
  That you the "onus" hide.

The *Santee* was condemned by act of Congress, August 5, 1882, and her name dropped from the *Navy Register*, but she continued as the post ship at the Naval Academy. It must have been at about this time that she was stripped of her spars and roofed over. Cadets still went to her for gun drill, but no longer actually fired the guns on her decks. In the successive numbers of the *Lucky Bag*, which began in 1895, there is frequent mention of her. The class histories show that the first installment of the new fourth class, who came in May—called Functions until the Graduation Ball, when they became Plebes—were quartered on her during

the spring months; and on their return from the summer cruise, while the three upper classes were away on leave, they spent September on her together with their classmates who had just entered and who were thus known as "Sep. Plebes." Then it was that the May Plebes hazed their less experienced fellows. The late comers were shown their inferiority by being taught that they *rated* only one side of the deck and that they must wear their hats squarely on their heads: "When a Sep. Plebe," writes the historian of the class of '97, "attempted to go through a port ahead of one of the May autocrats, or drink at the cooler before him, how quickly was he shown the errors of his way, and given a gentle reminder." The officers objected when the Sep. Plebes were made "to stand on their heads, slide down gangway ladders, answer to *noms de guerre,* etc."; a court martial followed, and "as a result several May Plebes languished."

When in trouble and disgrace,
Who protects the hardened case?
Who will, with parental care,
Shelter, shield, and keep him there?
The *Santee.*

Thus writes the bard in 1904, but the following year, when Admiral Sands began his administration, her use as prison ship was by official act ended. It was said she was unsanitary. However, until spring, 1912, the officer in charge of ships at the station, with his family, continued to make the frigate his home. A broad fireplace had been introduced in the captain's cabin; a sun parlor of ample proportions had been built above, which was filled with flowers and ferns. For years this sea-home was known as having a charm hardly surpassed in all the yard; and its loveliness was never more in evidence than during the last years of the frigate's career.

The end of a ship, as of a strong man, has in it so much of mortal struggle and agony that it should be passed over quickly. The waters finally prevailed over the *Santee* and drew her down. For years, like all well-regulated ships, she had been pumped out night and morning. In 24 hours she would average about 30 inches in her hold; at times the water might be slightly in excess of this, and especially in winter considerably less. "Why less in winter?" as an officer in charge of ships remarked, "I don't

know, unless what an old quarter-master told me is correct. He said it was because the crabs and eels crawled into the cracks during the cold weather and so made her tight." Without warning, about four a. m., April 2, 1912, the venerable ship began to settle, and as late risers gazed upon the world they saw her sunk 10 or 12 feet, resting on the mud, but still on an even keel. As the attempt to float her proved unavailing, she was sold on August 2 to Joseph G. Hitner, of Philadelphia, for $3610, the purchaser being required to remove her. Six months later she was raised, and early on the morning of May 8, 1913, in tow of a heavy tug she left Annapolis, her final destination, as announced, to be Boston, the port from which she had sailed to the Naval Academy in 1862, near to the place of her birth. There, with the advantage of the higher tides, she is to be beached and burned for the copper and brass in her hull. Thus the old frigate, so rich in her varied associations, passes into the great unknown.

> And the barge . . . .
> Moved from the brink, like some full-breasted swan
> That, fluting a wild carol ere her death,
> Ruffles her pure, cold plume, and takes the flood
> With swarthy webs. Long stood Sir Bedivere
> Revolving many memories, till the hull
> Looked one black dot against the verge of dawn,
> And on the mere the wailing died away.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE FLAG OF THE *CHESAPEAKE:* A PLEA FOR THE BANNER WITH FIFTEEN STRIPES.

By CAPTAIN W. F. HALSEY, U. S. NAVY.

The Royal United Service Museum of England, under the control of the Royal United Service Institute, was founded by King William IV, on June 23, 1831. This institution was known as the Naval and Military Library and Museum, and was originally located in Vanbrugh House, Whitehall Yard, London, a house designed by Sir John Vanbrugh, out of the ruins of Whitehall, which was destroyed by fire.

As the collection grew in importance, a more spacious building was required, and after a second change it was transferred to the present location, the Banqueting House of Old Whitehall Palace, a building sentimentally and historically connected with the life of the British Nation.

In the reign of James I, the old palace of Whitehall had become so ruinous that it was rebuilt, and the splendid structure that now contains the museum is a part of the original design by the celebrated architect Inigo Jones. Charles I commissioned Rubens to decorate the ceiling, for which work was paid the sum of three thousand pounds, and in appreciation of the beautiful result, the title of knighthood was bestowed upon the artist. The ceiling has been renovated four times, the final work being completed in August, 1907.

In the Banqueting House were held some of the many fêtes and masks of the time of James I. On the chill morning of January 30, 1649, King Charles I, walking between files of soldiers from his last night's resting place in St. James Palace, passed through the Banqueting Hall, and out of a window on to the scaffold in the open street. An inscription on brass has been placed in the Hall to recall this tragedy, and the window located. It was in

this building that Cromwell, in 1657, made the famous speech declining the crown which was offered by a party of adherents. In this house, on the Restoration, Charles II received the felicitations of both Houses of Parliament on his assurance of future well-doing. On February 13, 1688, both Houses of the Convention, in this Hall, waited on the Prince and Princess of Orange to offer them the crown, and on the same day William and Mary were proclaimed King and Queen. With the accession of the House of Hanover, the Banqueting House was, by order of the Government, turned into a church. In it the ceremonials connected with the distribution of the Sovereign Maundy benefactions took place annually until 1890. One of the last public acts of William IV was the reopening in state, on April 30, 1837, of the Chapel Royal, and from that date until the last day of 1890 this building, though never consecrated, was utilized for religious purposes.

It would be hard to imagine a home more singularly appropriate for the wonderful collection of the Royal United Service Institute—a fabulous wealth of historical relics of glorious events, participated in by the military services, and which cannot fail to awaken in any British subject the love of home and a patriotic admiration for those whose deeds added luster to England's glory.

To any man of military education and life, the museum is a source of unfailing interest and illuminating instruction. To an American Naval officer, there are some relics the sight of which cause conflicting emotions. Prominently displayed among other captured flags, not far from (to the English) sacred relics of Nelson and Trafalgar, Wellington and Waterloo, is a tattered flag, exhibit No. 1229, labeled "The Flag of the United States Frigate *Chesapeake*, taken by H. M. S. *Shannon*, on June 1, 1813"—a brief statement, wonderfully concise, and pregnant with historical memories. The flag is not complete, as parts of the fly, beyond and below the union, are lacking; but sufficient remains to show the fifteen stripes, and the arrangement of the fifteen stars; holes there are through the union, which may or may not have been made by projectiles. The records of the museum show that the flag was sold at public auction on January 30, 1908, at the rooms of Messrs. Debenham, Storr, and Sons, London, for £850 (approximately $4250).

Is it within the limits of propriety to obtain the return of this Flag? If it could be obtained, is the return desirable? To each of these questions, it is trusted, an affirmative answer can be given.

The writer was simply seeking information, and beyond such records of the museum as are open to public inspection, further search, lacking official authority, was not deemed expedient. What negotiations would be necessary to obtain the flag are not known, but it is hoped that others better informed on this subject will supply the information.

While the war of 1812 was to us most important, England at that time did not appear to take it so seriously. This is indicated in the History of the United States, studied during the first year at the Naval Academy, which states, in effect, that "at the time of the declaration of war by the United States (1812) England was so occupied with the conditions existing in Europe, that such declaration sounded as the wail of an infant." Perhaps it was considered that the colonies were lost beyond reclaim, and that too much consideration should not be given to this little war with the "States." These views may account for the fact that the British Government has not desired or did not desire to care for captured relics of the war, and that some were allowed to become the property of individuals. As noted, the flag of the *Chesapeake* was sold at public auction; was purchased by a native born American, who, self-expatriated, is now a British subject; and was presented by him to the British United Service Museum.

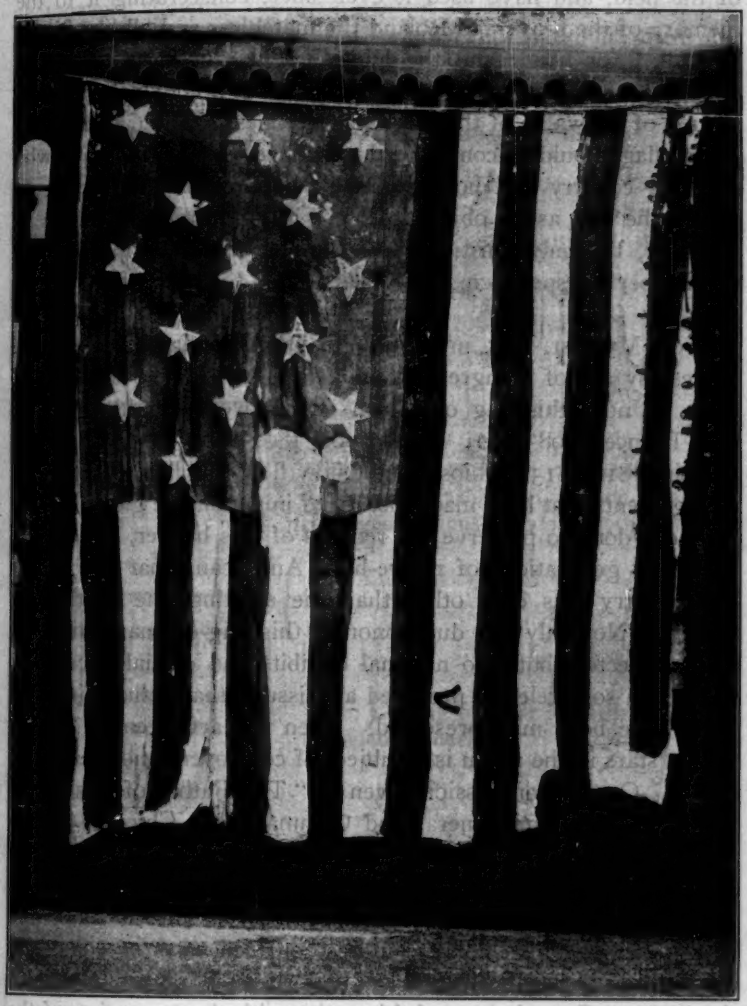
There are other relics of the *Chesapeake-Shannon* fight in this collection; Exhibit No. 532, "Signal Book of the American Frigate *Chesapeake*, with bullets attached to it for the purpose of sinking it in the event of the capture of the ship; together with a packet of papers relating thereto; given by Sir John Barrow, Bart. F. R. S." The capture of the signal book was reported by Lieut. G. Budd, U. S. N., the senior surviving officer of the *Chesapeake*, in a letter to the Department, dated Halifax, June 13, 1813; in which it is stated, in effect: "The signal book was not thrown overboard, and this book, with letters and papers belonging to Captain Lawrence, was taken. Immediately after the arrival of the prize at Halifax, the Brig *Nova Scotia* sailed for England with despatches, and there is no doubt the signal book was sent over by this vessel." Probably the signal book and papers (Exhibit 532) are those to which the report of Lieut. Budd refers.

Exhibit 531, "Walking stick made out of the taffrail of H. M. S. *Shannon,* shot away during the action with the American Frigate *Chesapeake*. This relic formerly belonged to Mr. D. Ramsey, who served as baker's boy on board the *Shannon.*" Exhibit 535, "Head of boarding pike, used in the action between the American Frigate *Chesapeake,* and H. M. S. *Shannon.*" Whether from accident or design, to Exhibit 531 (walking stick) is attached, in the catalogue, the English version of the engagement, a statement which, moderate in its tone, pays tribute to the gallantry of the *Chesapeake's* defenders.

From the information obtained, it is apparent that these relics were at one time in the possession of individuals and were not deemed to be government property. Considering this, would not the British government return the flag when adequate representations are submitted? It is believed the donor of the relic would not object to the action of the government.

The possession of the flag appears desirable for us—not to revive sad, and in some details mortifying, recollections, but as an object lesson, "Lest we forget." To the American student of our history there may be a ray of comfort regarding this engagement in the statement of Lieut. Budd, U. S. N., commanding the first Gun Division, and, as noted, the senior surviving officer of the *Chesapeake*. Lieut. Budd testified, before the Court of Inquiry, "The *Chesapeake* was never surrendered, the colors were hauled down by the enemy, and the ship was defended and guns fired after the colors were lowered." Further solace may be found in the opinion of the Court of Inquiry, of which Commodore Bainbridge was President: "The Court cannot, however, perceive in the almost unexampled occurrence of disastrous circumstances that the National Flag has suffered any dishonor from the capture of the U. S. Frigate *Chesapeake,* by the superior force of the British Frigate *Shannon* of fifty-two carriage guns, and 396 men. Nor does the Court apprehend that the result of this engagement will in the least discourage our brave seamen from meeting an enemy, hereafter, on equal terms." There is neither desire nor intention of renewing the controversy regarding the relative forces of the two vessels, but it does seem apparent that preparedness had much to do with the short engagement and decisive victory. Defeats are depressing, but in the light of other days defeats have been compelling forces, properly applied, that led to ultimate suc-

cess. Watson, in his inimitable "Story of France," tells of Charlemagne, the "towering figure" whose very defeats were



THE FLAG OF FORT MCHENRY, THE ORIGINAL "STAR SPANGLED BANNER."
The white edging at outside edges of outer red stripes is part of the material used to preserve the flag.

made glorious in song and story. "No great ruler ever waged more wars, won more battles, or died more victorious. Yet of all the battles, we know the most of Roncesvalles, the bloody skir-

mish where the Basques rushed from the mountain passes and cut down his rear guard in the Pyrenees. The poets took possession of the field, and have used it ever since, consecrating it to the memory of the brave—to Roland the matchless and all like him—who died for honor and the King." The *Chesapeake-Shannon* engagement is history teaching by example, a convincing confirmation of the value of thorough preparedness. The *Chesapeake's* sacred flag should be consecrated to the memory of the brave who died for country and honor. Perhaps more than the desire to obtain the flag as an object lesson, is the sentiment that this is, probably, the only existing naval flag of fifteen strips; not in itself a perfect specimen, but sufficiently so to show what the flag was.

From May 1st, 1795, until July 4th, 1818, the flag of the United States, by act of Congress, contained fifteen stripes and fifteen stars. Under this flag of fifteen stripes were fought the wars with France, 1798-1800; with Tripoli, 1801-1805; and with Great Britain, 1812-1815. Ships of our navy flew this flag in the many engagements that have made history of imperishable glory. What has been done to preserve the records of this banner, or to teach the many generations of native-born Americans that the flag of our country was ever other than the existing one of thirteen stripes? Not only has due honor to this flag of many victories been neglected, but also national exhibits and official documents have been so carelessly prepared and issued that actual historical facts have been misrepresented. Even the arrangement of the fifteen stars in the union is a subject of controversy not yet determined. On the commission given to "The Father of His Country," as Lieutenant General and Commander-in-Chief of all the armies of the United States, dated July 4, 1798, and signed by President John Adams, appears a representation of the national flag, which under the existing law comprised fifteen stars, and fifteen stripes. The union contains fourteen stars of equal size arranged in a circle, with a larger star (completing the fifteen) in the center. Commissions of this series with the engraving of the flag, as described, were issued to officers as late as the early part of the nineteenth century. In the Smithsonian Institution is preserved the flag flown over Fort McHenry at Baltimore during the engagement in September, 1814, the sight of which inspired the never-to-be-forgotten "Star-Spangled Banner." This histor-

ical banner is placed in a glass case, but the dimensions of the flag are so large that the details are not shown, but are supplied by a photograph, showing the arrangement of the stars. There are also shown, in the Smithsonian, political campaign flags of the

ARRANGEMENTS OF STARS, IN OUR FIFTEEN STARRED AND STRIPED FLAG FROM 1795 TO 1818.

No. 1. As agreed upon by Preble and Harrison.

No. 2. As shown on commission issued to General Washington, and on army officers' commissions early part 19th century.

No. 3. Flag of Fort McHenry (the star spangled banner).

No. 4. Navy flag according to Preble, not exactly like the *Chesapeake's* flag, but a near approach.

period on which the stars are arranged in the fourteen-starred circle with the larger central star. It is understood that Kentucky has this banner as a state flag, the change from the thirteen stars and thirteen stripes being due to the admission of Vermont in 1791,

and Kentucky in 1792. Admiral Preble, in his "History of the Flag of the United States," and Mr. Harrison, in "The History of the Stars and Stripes," unite in stating that "authorities generally agree in stating that the stars were arranged in three parallel lines of five stars each." The flag of Fort McHenry has the stars arranged in five parallel lines, three stars in each line, but staggered and not vertically under each other. Preble is responsible for the statement and picture of a flag of a portion of the period (1795-1818) carried by naval vessels, on which the fifteen stars are arranged in four parallel lines, four in the first, second and fourth, and three in the third line. The arrangement of the union of the *Chesapeake's* flag approaches this, but is not exactly the same.

In the Capitol at Washington, at the head of a much-used stairway is a large painting of The Battle of Lake Erie, a picture masterly in conception, and thrillingly beautiful in execution. The artist, Mr. Powell, has chosen for this masterpiece the memorable incident of the battle when Commodore Perry changed his flag from the disabled *Lawrence* to the *Niagara*. Probably a lack of professional knowledge, on the part of the artist, accounts for the carrying of the national flag in the bow of the boat in lieu of the service custom of shipping it astern. The flag is clearly depicted, each star, and each stripe, is distinctly shown; but, alas for historical accuracy, it is a flag of thirteen stars and thirteen stripes. This was not the flag of our country at the time, as the fifteen-striped flag had then (1813) been in existence for over eighteen years. The picture was painted in 1873, and the artist must needs have made some search to obtain data for a flag with thirteen stars; it is to be regretted that the search was not further continued, so that historical accuracy, in detail, was assured. Thousands of visitors see this picture annually; for a graphic description of this glorious engagement there could be no better view-point, where so many inquiring citizens seek information. Whether one in a thousand notes or does not note the error, the fact that the error exists remains the same.

In 1899, the Bureau of Equipment issued an edition of "The Flags of Maritime Nations," an official publication which up to this time is the only flag-book supplied vessels of the service. The edition is now obsolete, and many of the plates in the book are in error, but there appears on page 6, under title "Memoranda

Relating to the Flag and Seal of the United States," par. 6, the following statement: "In consequence of the admission of Vermont in 1791, and Kentucky in 1792, an act was passed as follows: 'Be it enacted, etc., That from and after the first day of May, 1795, the flag of the United States be *thirteen* stripes, alternate red and white, that the union be fifteen stars, white in a blue field.'" Of course the error is due to careless proof-reading; still, this book was the official reference flag-book for years, has not been replaced, and, so far as can be found out, the error has not been corrected. Mr. Barnes, in his "Naval Actions of the War of 1812," presents on page 62 a picture of "The *Macedonian* Crossing the Bows of the *United States*," and from the peak of the latter vessel flies, clear in all details, a flag of thirteen stripes; thus is history recorded.

The conviction exists that the flag of the *Chesapeake* would be desirable to have, to enable us to assist in the education of Americans in the history of the flag. This conviction may be emotional, but it is believed, nevertheless, to be sincere. The British, more than any other nation, guard as a sacred trust the relics that are interwoven historically and sentimentally with the records of the Empire. England would understand the sentiment that would prompt the request for the flag of the *Chesapeake*.

There is at the Naval Academy a British royal standard, taken by one of the officers of the squadron commanded by Commodore Chauncey, from York (Toronto), when a combined army and naval force descended upon that place during the war of 1812. This standard was given to the commodore by the officer making the capture, and was forwarded to the Department. Tradition has it that this is the only British royal standard ever captured. Honorable exchanges have ever been regarded with favor. Can we not exchange the only British royal standard ever captured for the flag of the only frigate ever captured from us in single combat?

In 1914, is to be celebrated the centenary anniversary of the signing of the Treaty of Ghent, to commemorate the peace of one hundred years between the two great English-speaking nations. It has even been proposed to erect in Westminster Abbey a monument to General Washington. Could there be a more appropriate occasion on which to exchange the flags, to cement further the friendship of the two nations by permitting each to come into its own?

The steps taken by some states to introduce and require, in the public schools, a study of the history of the flag are certainly moves in the right direction, to encourage patriotism and a love of the flag.

There have been born in our country ten consecutive generations of Americans, indicative of future happenings. Unless accuracy obtains in the dissemination of history, the fact that we ever had a flag of fifteen stripes will be forgotten. The navy can assist materially in this desirable educational campaign. Should we be fortunate enough to get the flag of the *Chesapeake*, direct that it be sent to the Naval Academy and carefully preserved. Require each student to make a sketch of this historical relic; it will never be forgotten. Have written a short, concise, and, above all, accurate History of the Flag; all could be compiled in a small pamphlet. Require further, that this history be taught and recited upon in the course of studies. Two, or at the most three, periods would suffice, and the time would be well spent.

Youth is impressionable, and the student midshipman cannot fail to be impressed by "glorious associations woven round the nation's flag; the memories that it will bring to him of great things accomplished, and great deeds done under its folds, by heroes past and present—the nation's flag and all it stands for, and for which thousands have fought, and died to win."

Do this, and though belated, we shall at least begin to show a nation's devoted respect to the fifteen-striped flag of glorious memories.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

BRITISH ROYAL STANDARD.

(From official catalogue of Navy Trophy Flags.)

By H. C. WASHBURN, Instructor, U. S. Naval Academy.

This rarest of all trophies was captured at York, (Toronto), then the capital of Upper Canada, on April 27, 1813, when that place was taken by the squadron under Commodore Isaac Chauncey and a land force under General Zebulon Montgomery Pike. General Pike met his death in the assault.

Commodore Chauncey wrote to the Secretary of the Navy, June 4, 1813, as follows:

SIR: I have the honor to present to you, by the hands of Lieutenant Dudley, the British standard taken at York on the 27th April last, accompanied by the mace, over which hung a human scalp. These articles were taken from the Parliament House by one of my officers and presented to me. The scalp I caused to be presented to General Dearborn, who, I believe, still has it in his possession.

The mace referred to, and a wooden lion, said to have stood in front of the Speaker's chair at the Parliament House, are also preserved at the Naval Academy.

The brig *Duke of Gloucester* was captured at the same time.

The Royal Standard of the United Kingdom of Great Britain and Ireland, in the heraldic blazonry here shown, was established by George III. It was first hoisted on the Tower of London and displayed by the Foot Guards, on January 1, 1801. Simultaneously, it was hoisted on Bedford Tower, Dublin, to celebrate the legislative union of Great Britain and Ireland. The United Kingdom dates from the first day of that year.

The three gold lions, "passant gardant," in the first and fourth "quarters," are for England; the red lion, "rampant," in the second quarter, is for Scotland; the gold harp, in the third quarter, is for Ireland. In the center, the shield or "escutcheon of pretence" represents the Hanoverian dominions in Germany,

including the arms of Brunswick (two gold lions on a red field), of Lunenburg (a blue lion, "rampant," on a gold field "semé of hearts proper"), and of Saxony (a silver, or white horse, "courant," on a red field). The shield in the center of the arms of Hanover is a further escutcheon of pretence, and bears, on a red field, the crown of Charlemagne, as the badge of the office of Arch Treasurer to the Holy Roman Empire. The arms of Hanover are surmounted by, or "ensigned with," the electoral bonnet, indicating that the ruler of Hanover was an Elector of the Holy Roman Empire.

On the death of William IV, in 1837, when Queen Victoria came to the throne, she relinquished the kingdom of Hanover to her uncle, the Duke of Cumberland. The escutcheon of pretence was therefore removed from the royal arms and standards, leaving the four quarterings for the three realms of the United Kingdom.

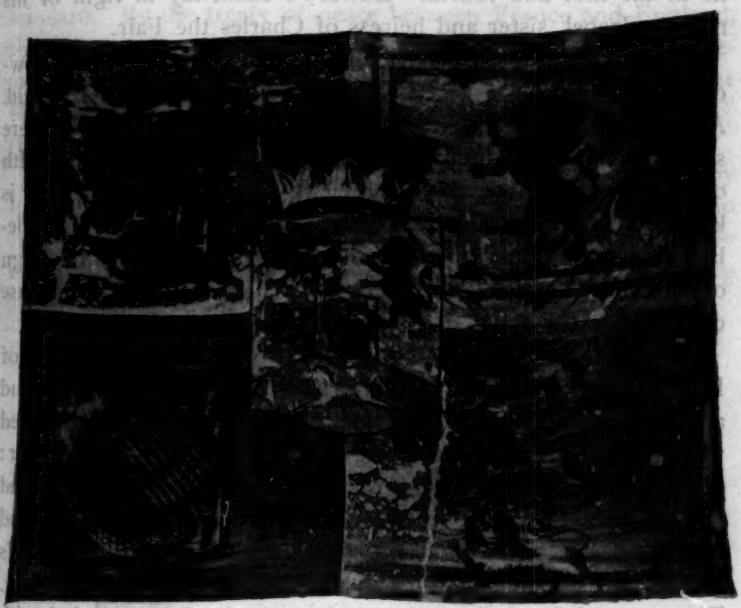
Since then, a slight change has been made in the royal standard. In the standard of King Edward VII, and in that of George V, which hangs in the chapel of St. George at Windsor, the "winged woman" form of the harp in the Irish third quartering, representing the ancient goddess Hibernia, is altered to a harp of old Irish design.

The royal standard is not meant to be carried into action, though certain lord high admirals, when in executive command, have been entitled to fly it from the mainmast of the flag-ship. Lord Howard spread it to the breeze on the *Ark Royal* when he defeated the Spanish Armada; the Duke of Buckingham flew it as lord high admiral in the reign of Charles I; the Duke of York fought under it when he commanded in the Dutch wars. At the present time, the commander-in-chief of a fleet hoists it at the mainmast on the King's birthday.

Usually, the standard denotes the presence of royalty on state occasions of the first ceremony. It floats over the palace where the King is in residence, is raised at the saluting point when he reviews his troops, and is broken out from the mainmast of any ship in his navy the moment his foot treads the deck.

The trophy standard captured at York, as heraldically described when its quarterings and escutcheon of pretence were established, is blazoned as follows: "Quarterly, first and fourth, *gules* three lions passant gardant in pale *or*, for England; sec-

ond, *or*, a lion rampant *gules* within a double tressure flory counter flory of the last, for Scotland; third, *azure*, a harp *or*, stringed *argent*, for Ireland. On an escutcheon of pretence, ensigned with the electoral bonnet, and divided per pale and per chevron, enarched with three compartments, the arms of His Majesty's dominions in Germany, viz., *gules*, two lions passant gardant in pale *or*, for Brunswick; second, *or*, semé of hearts proper, a lion rampant *azure*, armed and langued *gules*, for Lunenburg; third,



Armstrong, Annapolis.

THE BRITISH ROYAL STANDARD AT THE NAVAL ACADEMY.

gules, a horse courant *argent*, for Saxony. In the center, on an escutcheon *gules*, the crown of Charlemagne proper, being the badge of the office of Arch-Treasurer to the Holy Roman Empire."

William the Conqueror is said to have borne as his arms two gold lions passant gardant in pale *or* ("in pale" meaning arranged vertically down the middle; lions passant gardant occupying horizontal positions). It is known by authentic record that William the Second's royal arms were the same as the arms attributed to the Conqueror. The lions blazoned in this way are

known as "lions of England." Henry II added a third lion for the duchy of Aquitaine, in right of his queen, Eleanor of Aquitaine and Guienne. Successive sovereigns of England bore the arms of Henry II, until the reign of Edward III. In 1340, on claiming the sovereignty of France, Edward III quartered with the lions of England the fleurs-de-lis of France, the lions of England being in the second and third quarters, the fleurs-de-lis in the first and fourth. Edward's claim lay in right of his mother, Isabel, sister and heiress of Charles the Fair.

Until the year 1405 or 1406, the fleurs-de-lis had been "powdered," or "semé"; that is, strewn or scattered over the field. About 1406, in the reign of Henry IV, three fleurs-de-lis were substituted. This alteration had been made by Charles the Fifth of France about forty years previously, and constituted what is known heraldically as "France modern." The three fleurs-de-lis appear on the standard carried by the *Great Harry* in the reign of Henry VIII, and on a tapestry which hung in the old House of Lords in the reign of Elizabeth.

On the accession of James VI of Scotland to the throne of England, in 1603, when, as James I, he ruled England, Scotland and Ireland, the arms of Scotland and Ireland were combined with those of France and England, in the following manner: quarterly of four: 1 and 4, grand quarters, France and England quarterly; 2, Scotland; 3, Ireland. In other words, the first and fourth quarters were the same as the entire arms of Elizabeth's reign; the second and third quarters were as they are to-day. The arms of James I continued through the Stuart period with the same blazonry. The arms of the Commonwealth bore but little resemblance to the Stuart arms.

William III retained the arms of his immediate predecessors, but placed an escutcheon of pretence upon his shield and standard for Nassau.

Until the year 1707, when the legislative union with Scotland was effected, Queen Anne bore the same arms as had the Stuarts, save for the removal of the escutcheon of pretence for Nassau. In 1707, another change was made in the royal arms. England and Scotland were combined, by impalement, in the first and fourth quarters, with France and Ireland in the second and third.

The arms of George I were the same as those of Queen Anne, except that in the fourth quarter he placed the arms of Hanover, as they appear in the escutcheon of pretence of George III.

George III, from his accession until the year 1801, bore the arms of George I. On the first of January of that year, the fleurs-de-lis of France were by royal proclamation removed from the shield of England, and the royal arms and standards were blazoned, as previously described in this article, like the trophy standard. By the treaty of peace between France and England, signed at Amiens in 1802, the fleurs-de-lis, though already removed, were required to be erased for all time. From 1337, the King of England had styled himself, also, "King of France." George III was the first to relinquish that title.

The royal standard of George V is the same as the trophy standard, with two exceptions. Since 1837, there has been no escutcheon of pretence for Hanover; since Edward VII made the change, the harp of Hibernia has been superseded by a harp of ancient Irish design.

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STEAM TURBINES.[1]

By LIEUTENANT B. A. STRAIT, U. S. Navy.

Dr. G. Bauer and O. Lasche, in their excellent book "Marine Steam Turbines," have divided marine turbines into two classes: (1) Turbines in which the full expansion of steam from inlet to exhaust pressure takes place while traversing a series of turbine casings arranged for driving *two* or *more* shafts; and (2) turbines in which the full expansion of steam, from inlet to exhaust, occurs in a turbine on *one shaft*. As each installation is described, it will be apparent into which class it will fall:

THE CURTIS MARINE TURBINE.

The figure shows this turbine as installed upon the U. S. S. *North Dakota*. For the present only the action of the steam will be considered except where it is necessary to describe the construction in explaining the different phases of the steam action. This turbine acts upon the same principle as that shown in Fig. 12[2] and is merely an extension of the same with modifications to make it applicable to marine use.

Each of the first five stages is entirely separated from its neighbor by a diaphragm containing a nozzle. The sixth to the ninth (inclusive) pressure stages are mounted upon a drum; the object of this arrangement will be explained later.

The steam enters the turbine casing by way of the ahead steam chest, and after passing through the expanding nozzle, with the accompanying expansion and increase in velocity, it enters the first pressure stage, and, after passing through four rows of moving

[1] A continuation of the first paper, which appeared on pp. 293-311 of PROCEEDINGS for March, 1913.

[2] See page 310, PROCEEDINGS No. 145, March, 1913.

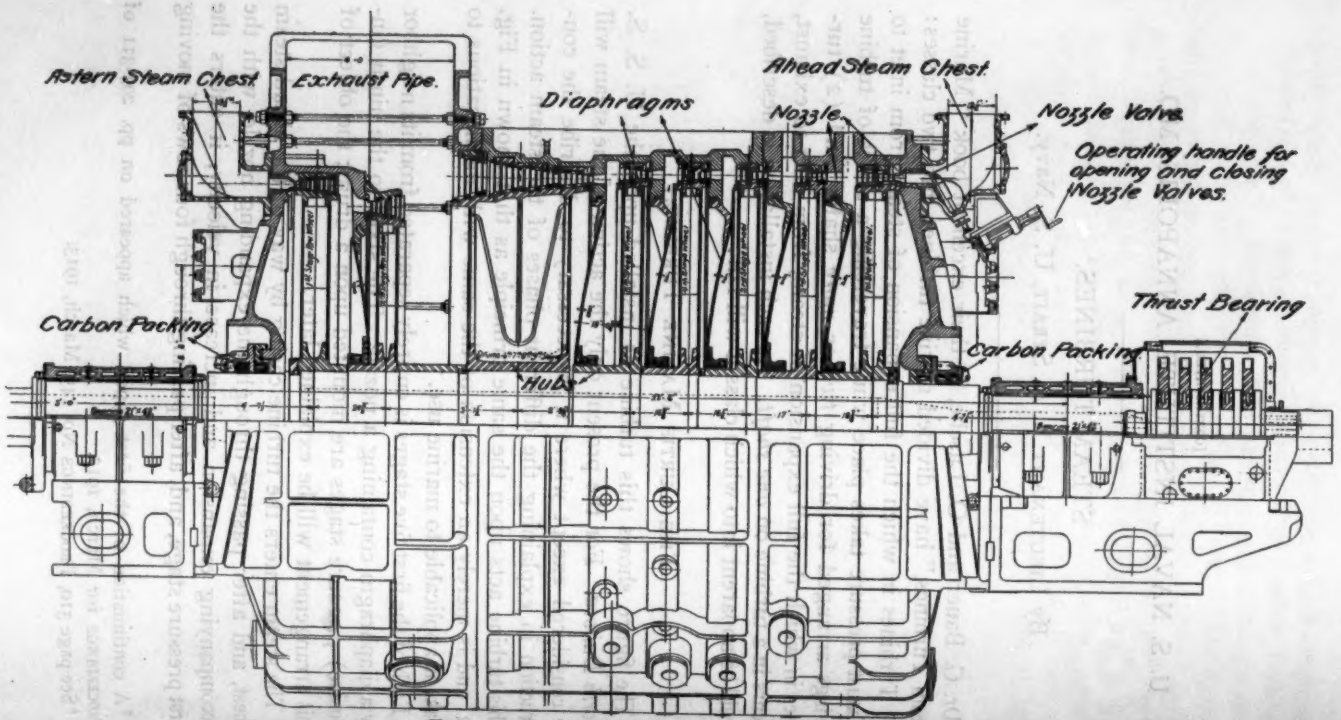

FIG. 13.—Curtis Marine Turbine (*North Dakota*).

blades most of its energy has been absorbed. The first pressure stage differs from the remaining pressure stages in that *expanding* nozzles are used and *four* velocity stages for the absorption of energy are employed.

These means are adopted so that the steam pressure may be reduced, in this case from about 285 to 75 pounds per square inch (absolute), thus relieving the casing of excessive internal pressures. In experiments with non-expanding nozzles, that is, one which has the same area of throat and mouth, it has been found that the ratio of the final pressure to the original pressure is approximately .58; so it is evident that if greater expansion is desired, as in the case of the first stage, an expanding nozzle must be used similar to the DeLaval nozzle.

By the use of such a nozzle a velocity is generated which warrants the use of four velocity stages. This arrangement upsets the equal division of the work performed by the several stages but more than compensates for the complication of design.

From the second to the sixth stages the expansion takes place in non-expanding nozzles of the same shape and size, the increase in volume being accommodated by the increase in the number used. As shown in Fig. 12 the fixed blades only occupy a segment of the circumference of sufficient distance to include the jet of steam, but as each expansion takes place a greater segment of the circumference is occupied by the jet. Upon the arrival at the sixth stage the nozzles occupy the whole of the circumference so for further expansion it is necessary that the radial height of the nozzles be increased.

Unlike the Parsons turbine there is no inequality in the pressure of the steam on the moving parts until the sixth stage where the blades are mounted on a drum. The pressure of the steam on this drum exerts a thrust in the direction of flow which counterbalances, to a degree, the propeller thrust.

FIG. 13.—Curtis Marine Turbine (*North Dakota*).

THE PARSONS MARINE STEAM TURBINE (FLORIDA).

This turbine is of the impulse-reaction type and in the classification given by Bauer & Lasche the expansion of the steam takes place while traversing various paths, but in every case it must traverse at least two casings arranged upon separate shafts; the distribution of power on each shaft being as nearly equal as possible.

As stated in the explanation of the principle of the Parsons turbine, the power is distributed through two or more casings for various reasons, but principally to do away with excessive longitudinal dimensions of casings, as would be necessary if high powers were confined to a single casing.

From Fig. 14, a typical battleship installation, the courses of the steam for various combinations used are as follows:

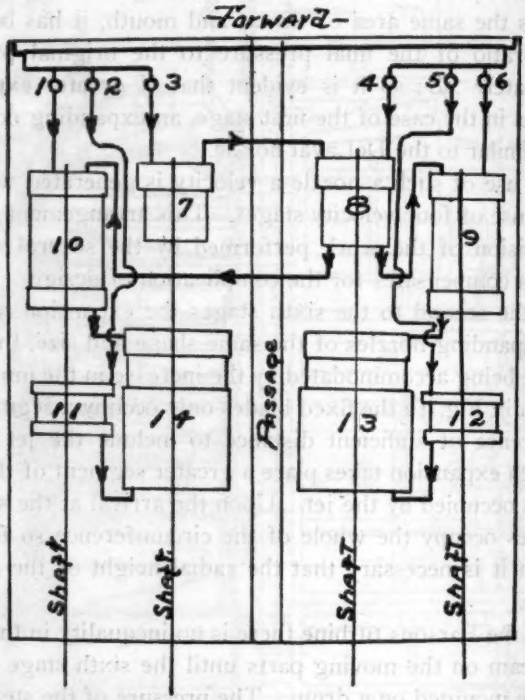

FIG. 14.

Ahead.—High Pressure Cruising combination is that combination which embraces all ahead turbines, the expansion is extended through a maximum of turbine elements with the result that the speed is limited by the steam available at the H. P. C. throttle (3) (the steam and exhaust pressures will be assumed as constant). The course of steam is as follows: Throttle *3* to H. P. C. casing *7*, to I. P. C. casing *8* at which point the steam divides equally and is carried to M. H. P. casings *9* and *10*, thence to the ahead elements

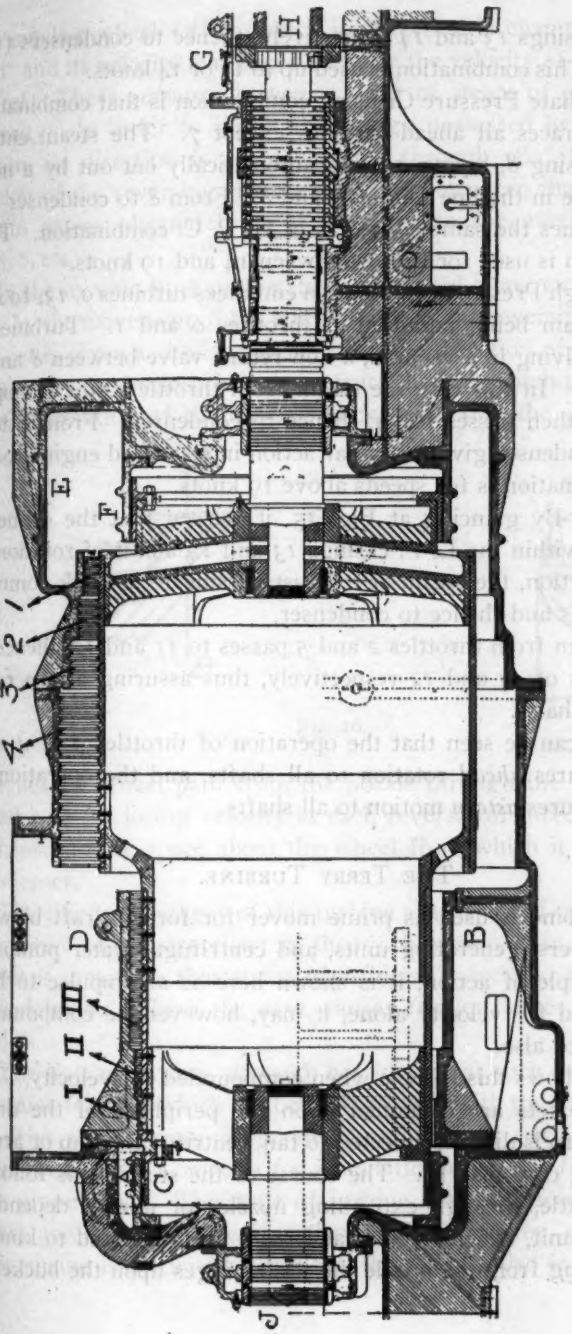

FIG. 15.—Low Pressure and Astern Turbine. Parsons Turbine.

A. Astern steam belt.
B. Drain well.
C. Dummy (radial type).
D. Exhaust for L.P. and astern turbine.
E. L.P. steam belt.
F. Dummy (contact type).
G. Expansion coupling between I.P.C. and P.L.P.
H. I.P.C. Shaft.
J. Gland.

of L. P. casings *13* and *14* respectively, thence to condensers (not shown). This combination is used up to 13 or 14 knots.

Intermediate Pressure Cruising combination is that combination which embraces all ahead turbines except *7*. The steam enters I. P. C. casing *8*, casing *7* being automatically cut out by a non-return valve in the line joining *7* and *8*. From *8* to condenser the steam pursues the same course as in H. P. C. combination. This combination is used for speeds between 14 and 19 knots.

Main High Pressure combination embraces turbines *9*, *13*, *10* and *14*, the steam being admitted at throttles *6* and *1*. Turbines *7* and *8*, revolving in a vacuum, a non-return valve between *8* and *9* isolating *8*. In this case the steam from throttle *1*, for example, enters *10*, then passes to *14*, thence to condenser. From *6* to *9* to *13* to condenser gives a similar action in starboard engine room. This combination is for speeds above 19 knots.

Astern.—By glancing at Fig. 15, it is seen that the elements contained within the L. P. casings *13* and *14* admit of rotation in either direction, the steam at exhaust passing to a trunk common to both ends and thence to condenser.

The steam from throttles *2* and *5* passes to *11* and *12*, thence to astern ends of *14* and *12* respectively, thus assuring astern rotation to all shafts.

Thus it can be seen that the operation of throttles *3* or *4* or *1* and *6*, assures *ahead* rotation to all shafts, and the operation of *2* and *5* assures *astern* motion to all shafts.

THE TERRY TURBINE.

This turbine is used as prime mover for forced draft blowers for destroyers, generating units, and centrifugal water pumps.

In principle of action, it is shown here as an impulse turbine compounded for velocity alone, it may, however, be compounded for pressure also.

Fig. 16 shows this turbine when compounded for velocity. The moving buckets are contained upon the periphery of the drum which in turn is direct connected to fan, centrifugal pump or armature, as the case may be. The course of the steam is as follows: From throttle, through expanding nozzles or nozzle, depending on size of unit, in which its heat energy is transferred to kinetic. Upon issuing from the nozzle the jet impinges upon the bucket of

the moving wheel (2) in which its direction is changed through 180° and its velocity is reduced by twice the velocity of the moving wheel. There remains, however, a jet of steam of considerable velocity. In order to utilize the energy possessed by this jet of steam, its direction is again changed through 180° by the first bucket of the reversing chamber 3. It is thus seen that the jet of steam passes alternately from the fixed to the moving buckets 4, 5, 6, etc.

In the moving buckets the steam is carried along circumferentially by the movement of the wheel, while in the reversing chamber, the jet is given a similar movement in the direction of the circumference by the buckets being constructed with a pitch in the direction of rotation of the moving buckets, so that the jet of steam

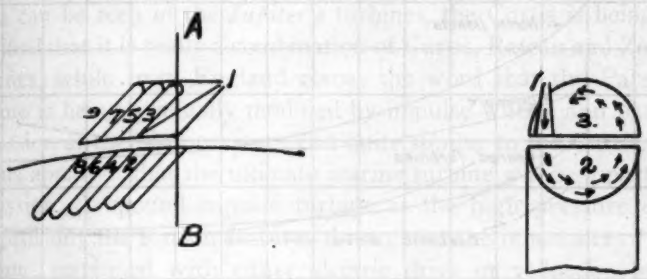

FIG. 16.

pursues an helical path from the nozzle through the moving and fixed buckets, losing velocity at each reversal of direction until it exhausts to the space about the wheel from which it exhausts to condenser.

The chief advantages of this turbine are: Ease of operation and simplicity of construction; in theory, however, it is not efficient for it is inevitable that steam of different velocities, so intimately associated as is here the case, causes friction losses from steam eddies.

The Rateau turbine, although not adopted as such in our service, contains features which are being combined with the Curtis turbine to drive the alternating current generator just completed by the General Electric Company for installation upon the *Jupiter* (electric propulsion). This type of turbine has been used abroad for years and is known there as the A. E. G. turbine, made by the Allgemeine Elektricitäts Gesellschaft. As installed in that turbine

the first pressure stage is compounded for velocity by having two rows of moving blades. Expanding nozzles are employed, thus reducing the steam pressure materially with the corresponding decrease in internal strains on casings, but principally to allow of shortening the axial dimensions by reducing the number of pressure stages, and also to minimize the expansion and contraction incident to a casing containing steam of such widely different temperatures. From the end of the first pressure stage to the condenser the Rateau feature of compounding for pressure alone has been adopted. That is, the steam passes alternately through

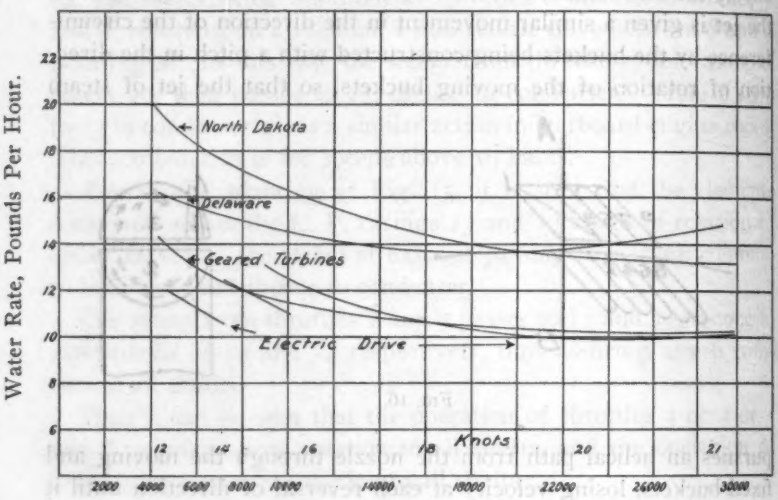

FIG. 17.—Shaft Horse-power.

non-expanding nozzles and single rows of moving blades. As in the North Dakota's turbines the nozzles occupy an arc of the circumference sufficient to contain the jet of steam.

A feature of the Zoelly turbine has also been adopted in this turbine. That is, the blades are so designed that the exit jet of steam makes a smaller angle with the plane of the wheel than the entering jet, while in Curtis' first turbine these angles were made equal.

A description of the Zoelly turbine would be a practical repetition of that of the Curtis in so far as the principle of steam action is considered. In fact a suit is now pending in the United States Court of Appeals to decide wherein the makers of the Zoelly tur-

bine can claim the right to manufacture without infringing the patent rights of the Curtis turbine.

The installations of the collier *Neptune* with the reaction turbines and the McAlpine-Melville reduction gear, and the collier *Jupiter* with compound impulse turbine and the electric drive have been presented to the service so often that such a description is not necessary, but the claims made by the two corporations back of these installations as to the performance which they will guarantee on a battleship of the size of the *North Dakota,* are plotted on Fig. 17 which also gives the performance of the *Delaware* (reciprocating), *North Dakota* (Curtis), and *Florida* (Parsons). A study of these curves will give an idea of the relative economy of the several types of prime movers at various speeds.

As can be seen in the *Jupiter's* turbines, the Curtis is being so modified that it is really a combination of Curtis, Rateau and Zoelly turbines, while from England comes the word that the Parsons turbine is being gradually modified by impulse wheels and partial admission at the high pressure end quite similar to the Curtis. It is thus apparent that the ultimate marine turbine will be a partial-admission, compound-impulse turbine at the high pressure end, and probably the Rateau features throughout the remainder of the turbine; combined with either electric drive or reduction gear, depending upon the outcome of the trials of the colliers.

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NOTES ON THE BALKAN WAR.*

FEBRUARY 20 TO MAY 15, 1913.

By LIEUT. COMMANDER RALPH EARLE, U. S. Navy.

Roumania and Bulgaria.—Bulgaria's misunderstanding with Roumania, mentioned previously, was over the region called Silistria. The two countries lie in different spheres of groups of the great European powers. If Russia is forced to take sides with Bulgaria, Austria must take up the cause of Roumania. M. Delcassé, the French minister to St. Petersburg, is reputed to have been primarily responsible for the adjustment of the differences. Silistria is to go to Roumania, together with compensation, because of her neutrality in the war. This decision was accepted by both countries on February 21.

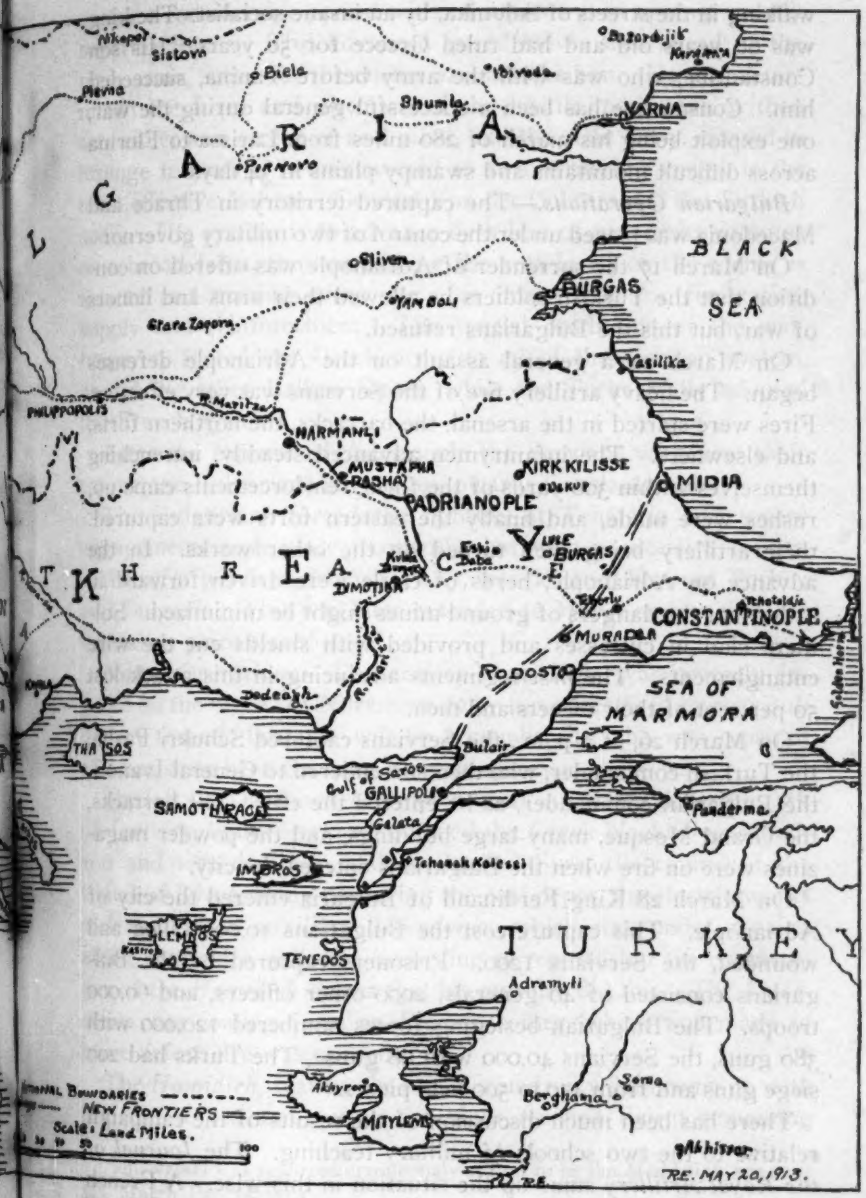
During February and early March heavy snows and blizzards stopped operations on the Gallipoli peninsula.

Both armies suffered much from the cold weather. Enver Bey's armada was broken up and the Greeks were prevented by strong gales from landing reinforcements in the Gallipoli campaign.

Grecian Operations.—On March 4 a series of assaults on Yanina was begun by the Greeks, the final result being the capture of the fortress at two in the afternoon of March 6, the successful operation being an attack in force by the left wing supported by simultaneous attacks by the right and center. This city, with its 32,000 troops, is considered the key of the province of Epirus. It is situated in the center of the grain trade, and, in consequence, its inhabitants had not suffered for food.

*Continued from page 347 of March PROCEEDINGS, 1913. As the dispatches of the Associated Press have been the source from which the major portion of this article is compiled it is possible that errors may be found, but for the most part the facts should be correct.

SERVIA
Priepoli
Sogitza
Novi Bazar
Aiem
Pirot
Mirdhita
MONTENEGRO
Berana
Mitrovitza
Leskovitz
Ipek
Pristina
SOFIA
CETTIGNE
Podgoritza
CATTARO
Dajakova
Prjarend.
Verisovitz
ANTIVARI
SCUTARI
Kustendi
DULCIGNO
USKUB
ST. JEAN DE MEDUA
Gulf of Drin
ALESSIO
ISTIP
Dibra
DURAZZO
Tirana
Elbasan
Ochrida
SKUMBI RIVER
MONASTIR
MACEDON
FIERA
Verbeni
NIGRITA
Berat
FLORINA
Sassena
Valona
KORITZA
SALONIKA
Servia
Mt. Olympus
YANINA
Kalambaka
Corfu
Mikhala
LARISSA
Volo
ARTA
GREECE
Prevesa


Nikopol
Sistova
Biela
Plevna
Shumla
Ibrivda
Bazardjik
Kurgan
VARNA
BULGARIA
PIRNOVO
BLACK SEA
Sliven
YAN BOLI
BURGAS
Stara Zagora
Yasilika
PHILIPPOPOLIS
R. Maritza
HARMANLI
MUSTAPHA PASHA
KIRK KILISSE
MIDIA
ADRIANOPLE
YULE BURGAS
DIMOTIKA
CONSTANTINOPLE
MURADBA
RODOSTO
SEA OF MARMORA
Dedeagh
R. Mesta
THASOS
Bulair
Gulf of Saros
GALLIPOLI
SAMOTHRACE
Galata
Panderma
IMBROS
Tchanak Kalessi
LEMNOS
Kastro
TENEDOS
TURKEY
Adramyti
Akhyraz
MITYLENE
Berghama
Soma
Akhissar
INTERNAL BOUNDARIES
NEW FRONTIERS
Scale: Land Miles.
RE. MAY 20, 1913.

On March 18 King George of Greece was assassinated while walking in the streets of Salonika, by an insane socialist. The king was 68 years old and had ruled Greece for 50 years. His son Constantine, who was with the army before Yanina, succeeded him. Constantine has been a successful general during the war, one exploit being his march of 280 miles from Larissa to Florina across difficult mountains and swampy plains in 34 days.

Bulgarian Operations.—The captured territory in Thrace and Macedonia was placed under the control of two military governors.

On March 17 the surrender of Adrianople was offered on condition that the Turkish soldiers be allowed their arms and honors of war, but this the Bulgarians refused.

On March 24 a general assault on the Adrianople defenses began. The heavy artillery fire of the Servians was very effective. Fires were started in the arsenal, the barracks, the northern forts, and elsewhere. The infantrymen advanced steadily, intrenching themselves within 300 yards of the forts, reinforcements came up, rushes were made, and finally the eastern forts were captured. their artillery being then turned on the other works. In the advance on Adrianople, herds of cattle were driven forward in order that the dangers of ground mines might be minimized. Soldiers clad in cuirasses and provided with shields cut the wire entanglements. The first regiments advancing in this attack lost 50 per cent of their officers and men.

On March 26, at 2 p. m., the Servians captured Schukri Pasha, the Turkish commander, who then surrendered to General Ivanoff, the Bulgarian commander, as he entered the city. The barracks, the Grand Mosque, many large buildings, and the powder magazines were on fire when the Bulgarians entered the city.

On March 28 King Ferdinand of Bulgaria entered the city of Adrianople. This capture cost the Bulgarians 10,000 killed and wounded, t'e Servians 1200. Prisoners captured by the Bulgarians consisted of 40 generals, 2000 other officers, and 60,000 troops. The Bulgarian besieging forces numbered 120,000 with 380 guns, the Servians 40,000 with 98 guns. The Turks had 200 siege guns and from 450 to 500 field pieces.

There has been much discussion of the results of the campaign relative to the two schools of military teaching. The *Journal of the Royal Artillery* sums up the situation in this wise. A French general trained the Greek troops, the system being that an army

is given an advanced guard of such a strength as to be able to hold on for a considerable period without support even against greatly superior forces. This advanced guard moves well ahead of the main army, seeks out the enemy and attacks him. Having determined the force and direction of the hostile movement, it then acts either as a screen or as a pivot, and the main army, massed in lozenge formation, is maneuvered so as to strike the enemy in the most effective fashion. General Von der Golz trained the Turkish army. His system is to advance by a line of numerous columns on a broad front, thus enveloping the area in which the enemy is located and making every use of a broad base for facilitating supply and reinforcement. The special conditions of the war, however, forced the Greek army to adopt the German system, as did the other Balkan States, while the Turks really adopted the French system.

After the capture of Adrianople the Servians withdrew their troops, the Bulgarians advancing towards Constantinople.

The Bulgarians forced the fighting at Tchatalja and severe engagements took place frequently, but with no decisive results. A truce for ten days, from April 17, was declared between Turkey and Bulgaria. This was later extended to May 5 and no fighting has taken place since.

Naval Operations.—The cruiser *Hamidieh*[1] was severely injured on the night[2] of November 22 by torpedoes fired by two Bulgarian torpedo-boats, it will be remembered. She was repaired and has since been the most interesting vessel in the war.

She left the Dardanelles, Hussein Rauf in command, on the 15th of January, lights screened, escaped the Greek blockading squadron and torpedo-boats, and bombarded Syra, the capital of the island of Syros, badly damaging the coal depot, the electric works and the Greek auxiliary *Macedonia,* which was under repairs. Her commander sunk her, according to reports, but the commander of the *Hamidieh* claims that his gun-fire did this. The *Macedonia* was coaling from an English collier, which was made to leave before fire was opened.

The *Hamidieh,* fearing the Greek squadron would come up with her, put to sea and during the night reached Beirut remaining

[1] This vessel was reported erroneously at first to be the *Medjidieh,* see page 345, March PROCEEDINGS.

[2] See page 342, March PROCEEDINGS.

there all day. Believing the enemy near, she sailed during the night for Port Said. Reaching there on the 24th of January, she took aboard a small quantity of coal and entered the Red Sea, filling her bunkers at Ras-Sudr, 20 miles to the southward of the Suez, and again took the sea.

On the 14th of February the *Hamidieh* reached Malta and, on account of a heavy gale then blowing, which her previous injuries possibly would not allow her to withstand, she was permitted to remain some time. She coaled on the 15th and sailed on the 17th.

On March 5 she was reported at the island of Symi in the Ægean, having previously attacked a Greek transport convoy, but this latter is denied by Grecian reports. On March 9 she arrived at Alexandria to take shelter from a gale of wind. Sailing on the 12th, she cruised along the Adriatic coast, and blockaded Albanian and Greek transports loaded with artillery for the siege of Scutari, which were unable to land it at St. Jean de Medua. The cruiser fired some shells at a hill on which was a Servian detachment and then bombarded Durazzo, the population of which took flight. Then the *Hamidieh* fired on the village of St. Jean de Medua and burned the Greek vessels *Cryssomalis, Syfneos* and *Verveniotes,* sunk the *Mania,* struck the *Elpis* seven times and the *Trifyllia* twice. Then the Turk fired on Alessio, and steamed to the southward towards Valona.

The *Hamidieh* arrived March 16 at Alexandria, steaming again on the 17th.

The *Hamidieh* had an encounter with four destroyers north of Durazzo and damaged the *Acheloos* severely.

On March 27 the *Hamidieh* is reported to have again bombarded and almost destroyed St. Jean de Medua, and is reported to have re-entered the Dardanelles some days later without detection.

The Turks naturally boast much of the exploits of their cruiser, but rumor credits the second in command, an Englishman, with the initiative.

These attacks are worthy of note as showing the danger of allowing even a single unit of a fleet to operate without opposition. The Greek fleet apparently could not detach a sufficient force from the blockade of the Dardanelles to hunt the *Hamidieh* down.

Apparently, the only Greek warship capable of defeating the *Hamidieh,* the *Averoff,* was severely disabled in the second engagement off Tenedos on January 18. The Turks stated that a shell

had struck the *Averoff*, wrecking her port engine and steering gear. This, at any rate, has been the last appearance of the *Averoff*. She must be under repairs, and hence the Greeks are unable to dispatch her to capture the *Hamidieh*. The rest of the Greek squadron is too slow and is needed for the blockade of the Dardanelles; it was dispatched in the latter part of April to find the *Hamidieh*, but met with no success.

The Aeroplane in the War.—Greece had an organized aero squad, with eight French-made machines. This number was increased, however, during the war. The Turks do not seem to have used aeroplanes to as large an extent. The scouting information obtained was invaluable, one instance being the detection, and consequent frustration, of a turning movement of 12,000 Turkish troops against the allies. One magazine in Adrianople was located and afterwards destroyed.

On March 21, in a flight lasting four hours and two minutes, the whole of the Bulgarian front was flown over, as well as the positions a good distance in the rear. During the four hours 275 miles were covered at an altitude ranging from 2500 to 8000 feet, and, although the aeroplane was subjected to continuous fire, no hits were recorded. As a result, the officer was able to draw up a report on the disposition of the entire Bulgarian Army, which must have proved of inestimable value to the Turkish commander-in-chief.

A Greek hydro-aeroplane from Lemnos, on February 6, flew over the Dardanelles forts and the anchorage of the Turkish fleet. The aviators used bombs. There being no accurate method in use, results were dependent on chance. Several aeroplanes were hit, one aviator, Popoff, an Austrian, being killed while flying over Adrianople. It appears that 6000 feet was developed to be the usual scouting height. It is possible from this height to glide long distances when hit.

Discord among the Allies.—The drifting apart of the allies showed itself first in early March, when on the 5th a fight between Greek and Bulgarian troops began over the possession of Nigrita. After three days fighting the Bulgarians surrendered.

The Greeks in Thrace and eastern Macedonia protested against being incorporated with Bulgaria. The Greek premier, Venezelos, announced, however, that Greece laid no claims to Thrace.

Greek and Servian cabinets became intimate, and strained rela-

tions with Bulgaria were shown before Adrianople when the Servians, after placing their artillery in position, refused for a week to participate in any active operations.

On April 11 the Servian troops that had been aiding the Montenegrins at Scutari were withdrawn, and began their return march to Servia.

Bulgaria resented forcibly the possession of Salonika by the Greek troops and advanced an army to dislodge the Greeks. The Greeks reinforced their troops here, sending a division from Epirus to Salonika early in April. In May Bulgaria showed a willingness to settle her differences with Greece and to forego her claim to Salonika.

The Servians demanded Monastir and sent a column on April 15 against it without success.

Operations in Albania.—March 25. Djavid Pasha, formerly military commander at Uskup, with 15,000 men, surrendered to the Servians on the Skumbi River in Albania. These troops reached Fiera, near the Adriatic Sea, about April 20 in a pitiable state, nearly starved, the whole of southern Albania having been practically denuded of means of subsistence by the various armies.

Austria's Interference.—March 28. The Austrian government, for the second time—the first was on March 20—sent a strongly-worded note to the Montenegrin government, making the following demands:

First—The free exit from the fortress of Scutari of all non-combatants.

Second—Explanations of the death of a Catholic priest, named Palie, who is said to have been slaughtered because he opposed the violent conversions of prisoners.

Third—Violent conversions to cease instantly.

Fourth—Full satisfaction to be given for the violence of the Montenegrins and Servians at St. Jean de Medua, on the Adriatic coast, against the crew of the Austrian merchant vessel *Skodra.*

With the view of hastening the solution of the question of Albania, the Austro-Hungarian government has agreed that the town of Jakova shall be ceded to Servia on condition that the northern frontier of Albania be delimited in conformity with Austria's wishes.

It was stated that Russia advised Montenegro to yield.

On March 31 three Austrian battleships, two cruisers and several torpedo-boats arrived within 20 miles of Antivari, the Montenegrin seaport. The 23d Regiment of Infantry embarked on the training ship *Zara* for a southern destination, probably Antivari.

An Austrian squadron of three battleships, two cruisers and several torpedo-boats was sent to Antivari; it had transports with 3000 troops. The first vessel captured by this blockading squadron was the yacht *Roumia*, belonging to King Nicholas, which was convoying three vessels laden with flour.

Montenegrin Operations.—April 2, after a desperate assault led by 200 bomb-throwers, the Montenegrin troops captured Tarabosch fort, one of the keys to the capture of Scutari.

April 11. The Servian troops withdrew from the siege, leaving the Montenegrins to work alone, the reason being that, as the powers had decided that the city must belong to Albania at the end of the war, further operations were unnecessary.

April 22. The Greeks and Servians have agreed with the Turks on an armistice and to commence the repatriation of Turkish prisoners of war. Austria stated that unless the Montenegrin troops were withdrawn immediately from Scutari her fleet would land troops at Antivari, Dulcigno, and St. Jean de Medua. A heavy, strong assault was made on the city by the Montenegrins.

April 23. Scutari surrendered to Montenegro. The Turkish commander, Essad Pasha, had forces of about 10,000; his losses were about 5000, and those of the Montenegrins about 3000 during the siege, which has lasted since October 24, 1912. The city was very much the worse for the bombardment, but food, except vegetables, had held out.

Austria stated that unless Scutari were abandoned she would herself capture it from the Montenegrins. The powers called the attention of the Montenegrin government to the fact that all the other states are yielding to their decision. Greece did not occupy Valona, Servia gave up Durazzo, Bulgaria did not move her army towards Constantinople, and therefore Montenegro must give up Scutari.

Essad Pasha, who had been permitted to leave Scutari on its surrender with all his troops, proceeded to Alessio in Albania, joined forces with Djavid Pasha, the former commander at Uskup, and on April 27 proclaimed himself as king of Albania, Tirana being designated as the seat of government. Essad Pasha was

assassinated on May 20; his successor has not been made known. Montenegro protested bitterly against the coercion by the powers, and, under orders, Crown Prince Danilo, leaving a small force at Scutari, marched to the defense of Cettinje against the Austrians. Austria was reported to have moved 40,000 troops toward Montenegro.

May 5. King Nicholas decided to evacuate Scutari and leave the settlement of its fate to the powers. This caused a resignation of his cabinet.

On May 11 the last of the Montenegrin troops left the city of Scutari.

Efforts towards Ending the War.—On March 2, in reply to questions by the powers, the Balkan States insisted upon the following conditions for the conclusion of peace, even through the mediation of the powers:

First—Immediate and simultaneous cessation of hostilities after the signing of the treaty of peace.

Second—Turkey must surrender to the allies Adrianople, Scutari, and Yanina.

Third—The Bulgar-Turkish frontier shall extend from Rodosto to Midia.

Fourth—The Peninsula of Gallipoli to be ceded to the allies.

Fifth—All the Ægean Islands, occupied at present by the Greeks, to be ceded to the allies.

Sixth—Prisoners of war and hostages to be exchanged with the briefest delay.

Seventh—Turkey to pay the allies an indemnity of nearly $300,000,000.

On March 5 the Balkan allies individually accepted in principle the mediation of the European powers for the conclusion of peace with Turkey. Each of them emphasized, however, the necessity for a consultation with the other nations forming the Balkan league before giving formal agreement.

The reply of the powers to the acceptance of mediation by the Balkan allies indicated satisfaction with their action, but suggested that the conditions should be modified with reference to boundaries proposed, indemnity, and the ownership of the Ægean Islands, but that Turkey should abandon all claim to Crete.

The allies' demands were considered extravagant, and Turkey declared it would continue the war, the cession of Scutari and the

Ægean Islands, together with the question of indemnity, being the disputed points.

On March 26 the powers proposed a new boundary line between Turkey and Bulgaria, to go from Midia by way of Muradli, above Rodosto, to the Gulf of Saros, thus excluding the allies from the Sea of Marmora, thus agreeing to the third proposal of the allies, but rejecting the fourth.

On April 6 the powers made concessions to the allies by proposing a frontier line between Turkey and Bulgaria that gives the latter nation both banks of the Maritza River and accepts the demand for indemnity, but leaves the amount to a technical commission.

Russia and France believe Greece should retain Salonika, while the Triple Alliance—Germany, Austria, and Italy—and England believe this city should be ceded to Bulgaria as a compensation for her cession of Silistria and a part of her own territory to Roumania.

At the present date, May 20th, the war seems to be at an end, no fighting having taken place since the evacuation of Scutari, and the preparation of the peace treaty going ahead on the lines indicated above. The boundaries of Turkey and Albania are to be as noted on the map. The latter is now an independent kingdom.

DISCUSSION.

A Study of the Development of the Method of Finding a Line of Position.

(See No. 145, pp. 211-220.)

Captain Armistead Rust, U. S. Navy.—1. Referring to par. 6 of Commander Marvell's paper, it is easy to find the true azimuth of the observed body by using the change of altitude in one minute, determined from the observed altitudes; with this rate of change per minute, the true azimuth is found from Plate II, as shown on page xiii of the "Ex-Meridian Tables" by the writer. (See also Proceedings, No. 123, page 959.)

2. Referring to pars. 14 and 15, while it is not practicable to compute straightaway tables within these narrow limits, yet it is entirely feasible to construct direct-reading diagrams which will give results sufficiently accurate, for the purposes of practical navigation; and attention is invited to a paper by the writer on this subject published in Proceedings, No. 107, of the U. S. Naval Institute, page 707, entitled "Tri-Rectangular Coordinates for the Solution of Spherical Triangles." It is being recognized by navigators that graphic methods for the solution of the every-day problems in astronomical navigation have many advantages over the slower and less accurate methods by computation, in these days of fast-moving ships and ever increasing speed. An error in computation, when making a landfall, has frequently caused disaster. The science of navigation is not up to date in this respect. This has been due largely to the difficulty encountered in attempting to project a spherical surface on a plane surface, which of course, generally speaking, cannot be done without distortion. Heretofore all graphic solutions of spherical triangles have been of a geometric nature; with the method of tri-rectangular coordinates, however, the solution is trigonometric, which is not only more accurate, no parallel rules or tracings being necessary, but is also much simpler in application to the various problems of navigation than any of the geometric methods or projections. One sheet for each degree of latitude, with a few supplementary diagrams for interpolation, is all that is necessary. Thus, 120 sheets would cover all portions of the globe usually navigated, extending from latitude 60 degrees North to 60 South. This method was only outlined in No. 107, but the writer hopes to finish a complete paper on this subject in the near future. Attention is invited to Problem IX, page 716, and to the method described for constructing the prime vertical or longitude diagram, which may be conveniently drawn on profile or cross-section paper.

3. Referring to pars. 19 and 23, when the azimuth is known, Table V or Plate II of the above "Ex-Meridian Tables" will be found convenient for correcting the altitude for minutes of hour angle when using Ball's tables,

if desired, though the reader is reminded that Mr. Ball explains how this interpolation may be avoided.

4. Referring to pars. 41 and 43, the writer believes that after the midshipmen are taught the theory of navigation, or rather along with the theory, their practical work should consist of practice in the most approved methods used at sea; while students should be taught to be *practically* accurate, they should be impressed with the fact that navigation at sea is not an exact art, and safety lies in continually checking the position by other observations. It is worse than useless to work closer than minutes of arc, as by no amount of figures can the error in position be made less than the final error of observation, as demonstrated by Commander Marvell; in fact, by such fine work with figures the navigator may be lead into a false sense of security and overconfidence in his position, which, when approaching the land, must always be checked by the lead.

The writer, while once looking over the navigation book of the captain of a sailing-ship, noticed that all of his sights had been worked with seven-place logarithms!

5. Referring to the last paragraph of the paper, attention is invited to the following books and pamphlets, in addition to those mentioned by Commander Marvell:

Davis' "'Chronometer' Tables," by P. L. H. Davis, published by J. D. Potter, London, England.

From these tables the hour angle may be quickly found without logarithms, from the altitude, as the altitude is found from the hour angle in Ball's tables. These tables embrace latitudes 0 to 50 and declinations 0 to 23, North and South.

Among the excellent works of the late A. C. Johnson, R. N., may be mentioned the following, published by J. D. Potter:

"A Hand-Book for Star-Double Altitudes."

"Brief and Simple Methods for Finding the Latitude and Longitude."

"How to Find the Time at Sea in Less than a Minute."

"On Finding the Latitude and Longitude in Cloudy Weather."

"Time Altitudes for Expediting the Calculation of Apparent Time."

The writer has found this book most useful, owing to the concise tables, the wide range in declination and the rapidity with which the hour angle may be found, thus making it possible to plot the position lines from three or four stars in the shortest possible time.

The formula from which the time-altitudes are computed may be deduced as follows:

$$(1)\quad \sin h = \sin L \sin d + \cos L \cos d \cos t$$
$$= \sin L \sin d + \cos L \cos d\,(1 - \text{vers } t)$$
$$= \sin L \sin d + \cos L \cos d - \cos L \cos d \text{ vers } t$$
$$= \cos (L - d) - \cos L \cos d \text{ vers } t.$$

$$(2)\quad \text{vers } t = \frac{\cos (L - d) - \sin h}{\cos L \cos d}.$$

$$(3)\quad \text{vers } t = \sec L \sec d\,[\cos (L - d) - \sin h].$$

In (3), $(L - d)$ becomes $(L + d)$ when the latitude and declination are of contrary names.

Table II, log of time-altitude is computed from the expression cos $(L - d)$ $-\sin h$, and is the log of the difference of the natural cosine and sine.

Another excellent work, similar to this last book of Johnson's, is "A Short, Easy and Improved Method of Finding the Apparent Time at Ship," by G. F. Martelli, for sale by J. D. Potter.

"Position-Line Star Tables," by H. B. Goodwin, R. N., published by J. D. Potter, furnished to all of our ships, contains tables for fixing the ship's position by reduction to the meridian or the prime vertical, without the use of logarithms, and may be used for the Marcq St. Hilaire and ordinary Summer methods.

6. It is recommended that, after having a small amount of work with the old methods by computation, the midshipmen be given thorough practice with the most approved modern tables and graphic methods, in order that they may be familiar with them before assignment to seagoing ships, thus enabling them to become of real use to the navigators when assigned to duty as their assistants.

7. In conclusion, it is recommended that the navy regulations in regard to the navigation work required of ensigns and watch officers be rigidly enforced on board all ships of the navy. This work should not be confined to deep-sea navigation alone, as is too frequently the case, but should include a study of the aids to navigation, charts of inland waters and practical work in coast piloting, in order that the junior officers may be prepared to properly perform their duties when assigned to torpedo-boats and other small vessels.

MR. FREDERICK BALL.—A letter to our Hydrographer follows:

7 NAVAL TERRACE, SHEERNESS, ENGLAND, April 15, 1913.

Commander George F. Cooper, U. S. Navy, Washington, D. C.

DEAR SIR: I have just received a copy of a paper written by Commander Geo. R. Marvell, U. S. N., on "A Study of the Development of the Method of Finding a Line of Position," which appeared in the UNITED STATES NAVAL INSTITUTE PROCEEDINGS of March, 1913, and am surprised that so erroneous an idea of the working of Ball's "Altitude Tables" as that on page 215 should not only have been shown by the writer, but that it should have passed without comment by those officers who were invited to offer suggestions on Commander Marvell's paper. So far from *six* operations being required, all of them being *multiplications*, in the determining of a position-line, there is not a single multiplication and only *two* subtractions, one in determining the solitary interpolation for the declination, and one in determining the azimuth. I think that the example attached makes this quite clear.

EXAMPLE OF THE USE OF THE TABLES.

At about 3^h p. m. the dead reckoning position was 49° 45′ N. 4° 0′ W The sun's true altitude was 15° 8′, G. M. T. $3^h\ 2^m\ 46^s$, declination S. 13° 15′. Equation of time $15^m\ 54^s$ + to mean time. To determine the corresponding position-line.

I.—Ball's Method:

	h. m. s.
	3 2 46 G.M.T.
	15 54 +
	3 18 40 G.A.T.
Assumed Longitude	° ′ 49 40
	3 40 W.
Hour Angle	46° = 3h 4m
Altitude from Tables	° ′ 15 14.1
Correction for 15′ declination	13.2 −
Calculated Altitude	15 0.9
True Altitude	15 8
Intercept	7.1 S. 46½ W.
to be laid off from	50° 0′ N. 3° 40′ W.

LAT. 50°		
Hour Angle.	DEC. 13°	14°
h. m.	° ′	° ′
3 0	15 41.9	
4	15 14.1	14 21.3
8	14 45.8	

For Azimuth,
15° 41.9′ — 14° 45.8′ = 56.1′.
Auxiliary Table, entered with Lat. 50° and 56.1′ gives S. 46½° W.

I also attach the working of the observations given on page 216 of the PROCEEDINGS, by means of the "Altitude Tables," no other book being used for corrections or azimuth, the latter being taken out just as in the preceding example:

h m s	☉ ° ′	Dec. ° ′	*Eq. t.* m s
W. 2 43 15	36 50	2 34.0	5 32.3
C.—W. 3 52 20	9.1 +	6.3 +	5 −
C. 6 35 35	36 59.1	2 40.3	5 27.3
C. E. 12 16 +			
G. M. T. 6 23 19			
Eq. t. 5 27			
G. A. T. 6 17 52	Z = S. 57° W.		
= 94° 28′			
Assumed Long. = 52 28 W.			
42° = 2h 48m			
From Tables h = 36° 15.′3			
Table III 31 +			
Calculated h = 36 46.3			
Measured h = 39 59.1			
Intercept 12.8 S. 57° W. from 40° 0′ N. 52° 28′ W.			

Of course, as Captain Lecky once remarked, every man thinks his own goose a swan, but I really think not only that the above method reaches the limit of simplicity, but that its accuracy is closer than that of any other abbreviated method. In the above example the azimuth is taken to the nearest degree, but a mental interpolation, occupying about five seconds, gives S. 56° 40′ W. I think that my claims to accuracy and brevity could not have stronger support than that of the practical seamen whose remarks are appended.

I should be greatly obliged if you would be so good as to forward this letter to the editor of the PROCEEDINGS of the U. S. N. Institute, for although I am aware that other tables have recently been adopted for official use, I should be sorry for my own tables to be generally misjudged, as they appear to be by Commander Marvell. I am, yours very truly,

FREDERICK BALL.

H. B. GOODWIN.—Navigators all the world over owe a debt of gratitude to Commander Marvell for his lucid and exhaustive account of the evolution of the position-line methods of fixing a ship's place, which now everywhere holds the field. It is very interesting to read how the double-chronometer, the only form contemplated in the first instance, gave way to the combination of longitude by chronometer with latitude by ex-meridian, to be supplemented in special cases by two ex-meridians, and to be superseded eventually by the system of "calculated altitudes," which has the great advantage of applicability in all cases alike.

The historian of the future will be somewhat puzzled to fix the exact dates when the various Sumner processes were first practically used at sea, and when the various modifications were introduced.

It is probable that the publication of the epoch-making volume of "Azimuth Tables" (Lat. 30° to Lat. 60°) by Commander Burdwood, about 1866, supplied the first impulse. For it is obvious that the process originally proposed, involving four longitudes by chronometer, or two longitudes and two altitude-azimuths, with a diagram accurately laid off to scale, was little, if at all, less laborious than the working of one double altitude, and one longitude by chronometer, and certainly not less tedious. But this at least is certain, that the system of "calculated altitudes" was first proposed by the late Admiral Marcq St. Hilaire in the *Revue Maritime et Coloniale* in the year 1875, and that in the course of his paper he referred to the system of combining one observation for longitude with a second one for latitude, as a modification recently introduced by certain brother-officers of his own navy. The advantages of having one method of procedure applicable to all observations alike soon became obvious to the French navigators, but it is only within quite recent years that the system has been adopted at all generally in other countries.

From the details given in the paper it is obvious that of late years considerable changes have been made in the methods followed at the Academy in the purely astronomical calculations. It is good to know that the haversine formulæ have to a large extent superseded the old sine and cosine methods for calculation of latitude, hour angle and azimuth. These haversine processes, which seem to have been introduced by Mendoza Rios about 1801, were greatly improved by Dr. Inman, professor at the Portsmouth Naval College, 1807-1837, and have been in general use in the English Navy for at least a century; they have too long been a purely British monopoly.

Amongst the formulæ quoted as used at the Academy to-day, one omission occurs which is a little surprising. In Section (3) "time-sight formula, assuming one latitude, result one longitude and azimuth"; and again, in Section (6), the azimuth is calculated by the haversine formula for three sides given. Since both zenith distance and hour angle are known, it would appear to be equally accurate, and would give less trouble, to employ the ordinary sine formula

$$\sin Z = \sin h \sin p \operatorname{cosec} z$$

in such cases, at all events when the body is not near the prime vertical. The calculation of Z, however, is only required in exceptional cases,

because, as is mentioned in the paper, "Z is already arranged for in the azimuth tables and diagrams."

So completely do the azimuth tables cover the ground, that, in designing position-line tables to reduce the labor of computation, it is indeed actually necessary to consider the zenith distance only. It is a special feature of the Marcq system of position-lines that, owing to the double assumption of longitude as well as latitude, it adapts itself readily to solution by such tables, and in the numerical example worked in the paper the author, after working out the position rigorously by spherical trigonometry, employs the special tables of Lieutenant de Aquino to attain the same result by less laborious means.

Towards the end of the paper the hope is expressed "that other methods may be carefully examined and worked, to see if they are not better than the one finally worked in this article." Availing myself of this invitation, and to illustrate the variety of treatment which the problem permits, I would ask permission to offer two other solutions.

With regard to the first of these, the present writer has already had the honor, in a former number of these PROCEEDINGS (No. 1, Vol. 38, March, 1912), of enunciating the principles upon which the method is based. It will therefore only be necessary to work the example by means of extracts from the tables. The data are as follows:

March 27, 1912, Lat. 39° 45′ N., Long. 52° 30′ W. True Z. D. sun 53° 1′. Greenwich apparent time $6^h\ 17^m\ 51^s$. Sun's Dec. 2° 40′ N. increasing. Sun's bearing S. 56°.5 W. To calculate the zenith distance, and deduce position-line.

The latitude assumed will be the nearest complete degree, viz. 42°. For the longitude we have

Greenwich A. T. $6^h\ 17^m\ 51^s$ =	94°28′
Longitude assumed	52 28 —
Hour angle	42 0

The extract from table will be as follows:

Hour angle 42°

Latitude	Declination 0°		
	Z. D.	Log for Cor. A.	Log for Cor. B.
40°	55° 18′	9.89314	5.5926

From the value of zenith distance given for declination 0°, we have to deduce the value to be applied to it for a decrease of polar distance of 2° 40′, or 160′, the work being as follows:

For Correction A.		For Correction B.	
Log 160	2.20412	Log $(160)^2$	4.4082
Log from Table	9.89314	Log from Table	5.5926
Sum	2.09726	Sum	10.0008
	125′.1 —		1′ +

Correction A is subtractive, because polar distance is decreasing. Correction B is always additive. The total correction is $-125'.1 + 1' = -124'.1$.

Then

Z. D. (Table)	55°18′	
Correction	2 4 —	
Z. D. (Calc.)	53 14	
Z. D. (True)	53 1	
Intercept	13	Nearer to sun

Thus, from the assumed position of 40° N. 52° 28′ W. we have to lay off a line S. 56°.5 W. 13′, giving the approximate position

39° 53′ N.
52 42 W.,

the line drawn through this point at right angles to the bearing of the sun being the position-line.

The method which follows is based upon a paper which appeared in a recent number of the *Revista Maritima Brazileira,* by Lieutenant R. R. Braga, of the Brazilian Navy. The writer's share in the matter is chiefly the adaptation of the process to the table of natural haversines.

With the usual notation p = polar distance, c = colatitude, h = hour angle, z = zenith distance, we have in the general triangle of position

$$\begin{aligned}
\text{hav } z &= \text{hav } (p-c) + \sin p \sin c \text{ hav } h \\
&= \text{hav } (p-c) + [\text{hav } (p+c) - \text{hav } (p-c)] \text{ hav } h \\
&= \text{hav } (p-c)\ (1 - \text{hav } h) + \text{hav } (p+c) \text{ hav } h \\
&= \text{hav } (p-c) \cos^2 \frac{h}{2} + \text{hav } (p+c) \text{ hav } h \\
&= \quad \varphi \qquad\qquad + \quad \theta
\end{aligned}$$

If, therefore, we tabulate the values of θ and φ, for values in the one case of $(\theta + \varphi)$ and h, and in the other of $(p-c)$ and h, we arrive at a method of finding the haversine of z by the simple summation of two quantities.

Again, since we are at liberty to choose for our assumed latitude and longitude those of any point in the neighborhood of the dead-reckoning position, we may so select them as to make one of the quantities $(p-c)$, $(p+c)$ say $(p-c)$, an integral number of degrees, and h also an exact multiple of 4^m, that is a whole degree also. The amount of interpolation required, therefore, is quite insignificant.

Treating the practical example already noticed by this method, we shall have for the data, as before,

Lat. 39° 45′ N., Long. 52° 30′ W. True Z. D. 53° 1′. G. A. T. $6^h\ 17^m\ 51^s$. Dec. 2° 40′ N. Azimuth S. 56°.5 W.

The assumed latitude being such as will render $(p - c)$ a whole degree, we shall have

p	87°	20′	G. A. T.	94°	28′
c	50	20 (for Lat. 39° 40′)	Long.	52	28
$p - c$	37	0	Hour angle	42	0
$p + c$	137	40			

From the tables we should have

Hour angle 42°

θ			φ	
$p + c$		$\delta\theta$ per 10′	$p - c$	
		Add		
137°	.11118	12′	37°	.08775
138	.11194			

θ	.11118	Calculated z	53° 3′
Parts for 40′	.00048	Observed z	53 1
φ	.08775	Intercept	2′ Nearer
Nat. Haversine z	.19941		
z	53° 3′		

Thus a point is determined 2′ S. 56°.5 W. of 39° 40′ N. 29° 28′ W., which will be found to lie in 39° 39′ N. 52° 30′ W.

We have now four points in all, as follows:

By rigorous process in paper	39° 45′	N.
	52 35	W.
By method of Lieutenant de Aquino	39 35	N.
	52 25	W.
By the $\frac{dz}{dp}$ method	39 53	N.
	52 42	W.
By method of Lieutenant Braga	39 39	N.
	52 30	W.

If these positions are duly laid off upon a chart, they will be found to lie close to a line running approximately N. 33°.5 W., at right angles to the bearing of the sun when observed. Any one of these positions being found, therefore, a line which contains the position of ship is determined.

With regard to the two alternative methods introduced, the special features of the first one, the $\frac{dz}{dp}$ method, were fully considered in the paper published in the "PROCEEDINGS." It is only necessary to add here that, in

tabulating, it would be easy to frame a table giving the value of correction B at sight, and thus save one summation.

In the case of Lieutenant Braga's process, it may be of interest to consider its advantages in connection with the tests suggested by Commander Marvell, who says "The main things to be kept in mind are accuracy of tables, compactness and small number of books, and ease of solution."

That the tables should be accurate, and therefore reliable, is of course a first essential condition for all tables alike, great and small. This perhaps may be taken for granted.

From considerations of convenience, as well as of expense, it is obvious that any tables intended for general use should not be too voluminous.

Two tables, one for θ and one for φ, each of about 8000 entries, occupying in all some 40 pages, would suffice for θ and φ. If a table of natural haversines to minutes were included in the same volume, only one book would be required, but, as the table is generally to be found in nautical collections, it might not be considered necessary to include this, and in that case two books would be required.

The question of "ease of solution" is of the first importance, for it must be remembered that navigators are in general simple, unlearned men, for whom everything should be made as easy as possible.

In the matter of simplicity, the Braga method seems to leave nothing to be desired. Here we have hardly any multiplication, no division, no discrimination as to algebraic signs, no question as to the quadrant to which an angle belongs, no precept but the simple rule "Add value for θ to value for φ, and look out the sum as a natural haversine."

Our additional test, which lies outside the list given in the paper, may perhaps be added, that of general applicability. Some tables have only a partial application, and have a way of failing in particular cases. Thus, Mr. Ball tells us that "for altitudes above 70° the method of his tables is not recommended." With other tables we may get into troubled waters near the prime vertical, and so on. The Braga method, as has been shown, simply throws a perfectly general formula into a shape which renders tabulation easy, and the natural haversine obtained is practically identical with that arrived at in the ordinary course with an expenditure of much more time and trouble.

Reverting to the example worked above by means of θ, φ, if this were treated by the formula given under heading (5) amongst the methods now practiced at Annapolis, we should have

$L \cos L$ (39° 40′)	9.88636
$L \cos d$ (2° 40′)	9.99953
L hav t (42°)	9.10866
	9.99455
θ	36° 38′
hav θ	.09876
hav $(L-d)$ (37°)	.10068
hav z	.19944
$z=$	53° 3′

Comparing the almost identical results obtained by the two methods, we see that by the tables proposed the solution of the general spherical triangle is assimilated to that of the right-angled or quadrantal triangle in respect of labor involved.

The table in the paper which shows the actual time spent, and other details in the various calculations, is a very instructive one; but so far as time is concerned, the comparison cannot be pressed too closely, because a computer naturally deals more quickly with those processes with which, through actual daily practice, he has become most familiar. In connection with the question of the importance of "short cut" methods generally, a new departure recently taken in some countries with regard to the special seamen's edition of the official *Nautical Almanac* published therein, is not without importance. The British navigator, for instance, will be agreeably surprised to find at the end of the present year that the small *Almanac* for 1914 has been entirely rearranged, with a view to give him exactly those things which he requires, disposed in the most convenient form. The elements for the sun, formerly given for noon only, have been tabulated at two-hour intervals, with the result that declination or equation of time can be taken out practically at sight.

Now it will be noticed that, in the table of the paper, the amount of time "common to all" methods, viz., that occupied in correcting altitude and elements from *Almanac*, is set down at five minutes, a quite reasonable estimate. If, however, the altitude is corrected in a single term, and if declination and other elements are taken out at sight, this time need hardly occupy more than one minute, so that, comparing the total time occupied by the Aquino process with that of the altitude haversine formula, whereas we should have had formerly

	Alt. Hav. Formula.	Aquino.
Common to all	5	5
Add	7	4
Total	12	9

the comparison, working with the 1914 *Almanac*, would be

	Alt. Hav. Formula.	Aquino.
Common to all	1	1
Add	7	4
Total	8	5

Thus, the proportion of time saved by the use of the shorter process is raised from one-fourth to three-eighths of the whole amount. The same form is adopted for the German seamen's *Almanac*, and the example now set will doubtless be followed later on in other countries.

The present condition of affairs is undoubtedly a little chaotic. Navigators have renounced their ancient shibboleths, but as yet no general agreement has been arrived at as to what should be set up in their place. It is,

therefore, much to be desired that Commander Marvell's appeal to his brother-officers to come forward and give their experiences should meet with a ready response.

LIEUT. COMMANDER H. P. PERRILL, U. S. Navy.—The writer shows that progress in the art of navigation tends toward simplicity in calculation, and arrives at the conclusion that the method of finding the line of position by Aquino's "Tables" is the best yet published. My own experience confirms this conclusion.

Accepting the challenge of the writer in the last paragraph of his valuable article, I venture to set forth my own experience. Some time before I was ordered to duty as a navigator, I had procured a set of Aquino's "Tables," and theoretically at least was familiar with their use before I had opportunity to put them to the test. This was some time before the Navy Department began issuing the book to ships' libraries. Prior to this time all my work in navigation had been done by the methods I had learned at the Academy. For a short time I worked my sights by both the time-sight formula and Aquino's tables, until I had convinced myself of the essential accuracy of the latter. At the same time I required a junior officer to work simultaneous observations with the Marcq St. Hilaire formula given in Muir, equation (5) of the article. This last formula I have scarcely used myself. The greater ease of the solution by Aquino's tables, together with virtually the same degree of accuracy, convinced me that the tables furnished me the more desirable method.

The next step in my education came when I took up the haversine method. This was then rapidly coming into extensive use in our service and I wanted to learn it. I now use either method, and frequently work out my sights by both methods. It may be asked why I go to so much trouble. Initially I did it for purpose of comparison. Then one method serves as a check on the other. Moreover, the haversine method may be said to have the weight of greater sanction, since it is much more extensively used in our service, and since the Department encourages its use by providing in the "Useful Tables" a table of haversines; whereas the issue to ships of Aquino's "Tables" is of comparatively recent date, and it is furnished to libraries much as other reference books are issued.

A comparison of the two methods is desirable. The great superiority of Aquino's tables lies in the fact that the azimuth is obtained at the same time as the altitude and without any additional calculation. But if two or more simultaneous observations are to be worked out, each solution brings out its own "assumed position," requiring additional work in plotting the lines. In a new edition of his "Tables," Lieutenant Aquino has endeavored to get around this difficulty, but after a careful perusal of the review by Commander Hoff in the UNITED STATES NAVAL INSTITUTE PROCEEDINGS (whole No. 143, September, 1912) I fail to see that the method has any great superiority over the haversine method.

Up to a certain point the work involved is precisely the same in the two methods. In the haversine method the work of computing the altitude does not greatly exceed that in the Aquino method, nor is the liability to error

much greater. The objectionable feature is that the azimuth can only be obtained by a separate calculation. The labor involved in this calculation is reduced to the minimum by the use of Weir's Azimuth Diagram, furnished with all navigation outfits, mounted as explained by Commander Logan in his article in UNITED STATES NAVAL INSTITUTE PROCEEDINGS (whole No. 128, December, 1908—the same number, incidentally, in which Lieutenant Aquino presented his method to our service). The "computed position" with this method is the D. R. position, which must be plotted in any case. Consequently the use of the haversine method for computing altitudes, and of Weir's diagram for finding the azimuth, is especially applicable when two or more simultaneous sights are to be worked out. In my opinion very little more work is involved than in the use of the Aquino method.

I never use the time-sight any more. As for the φ'' φ' sight, I have forgotten the formula. The Marq St. Hilaire method takes the place of both of them, and its use constitutes a long step toward the desired simplicity. The rivalry lies between the various ways of working it, with the odds favoring Aquino's method.

Trained Initiative and Unity of Action.

(SEE NO. 145, P. 41.)

COMMANDER W. W. PHELPS, U. S. Navy.—Lieutenant Commander Knox has clearly analysed the effect of *defective naval discipline;* preventing, as it surely must do all the way up the ranks and grades, the understanding of how to *command correctly.* He has given us manifestations of our cumbersome and complicated system, and, in the remedy he proposes, he has gone far; but it would not appear that he has gone entirely to the bottom of the trouble. We should first get at the root of our disease, then his excellent remedy would have healthy tissue to build on. The situation in the Navy to-day has its parallel in the volumes of enactments congresses and legislatures pass year after year to cure trusts and monopolies—the products of a fundamentally vicious and unnatural economic system, while they do nothing to correct the vicious and unnatural economic system whose natural offspring are those same oppressive monopolies.

It is a striking thing that all studies of the principles that should underlie us as a Navy, with the notable exception of the studies of Mahan, largely draw their precepts from the land compaigns of great generals. Why is this? It seems to be because we must necessarily study organizations and systems that are through and through *military* in methods, in spirit, and in relationships, if we are to draw from the study of warfare things of value to our profession. Why is it, that in all the hundred and twenty-four years of the existence of the Navy, the spirit of the service, which in all these generations has been handed down, has lacked the simple, sound military principles of the initiative and command so ably formulated by the essayist? It seems to be because the Navy has never yet been founded on the principles of military command and military relationship. The industrial foundation of the Navy is a foundation of sand. The military foundation of the

Navy will be a foundation of rock. Therefore, if we are going to be able to correctly apply lessons, so as to evolve the excellent doctrine the essayist advocates, it would seem that we *must* first organize so that our very organization, methods and relationships are thoroughly military down to the smallest units, " . . . down to the corporal's guard, . . . ," as the essayist (page 42) quotes from Hamley. And does not the essayist quote (page 56) Wilkinson, who says: "The two functions of directing the movements so as to secure victories, and of managing the great business concern, have little in common . . . " ? We must drive the industrial spirit into the background of the Navy and bring the military spirit into the foreground of the Navy.

The essayist gives under his Rule I (page 59) the almost perfect outline of navy organization, namely: "Fleets. Squadrons. Divisions. Ships. Ship departments. Ship divisions. Squads." And note this essential—"Every group shall have a commander whose duties and responsibilities shall be clearly defined and understood." Without military relationships, without the command responsibility, confided to the group commander *even to the smallest unit,* we will fail in the fundamental outline of the organization. The "initiative" must underlie the very spirit of the system. The young officer, just graduated, must be in the atmosphere of the training in "initiative" at the very start, because his training begins in the simple command of a few "squads"; and if there is no *military command* by which he can impress his will on the elements of the small units, and thus at the outset learn (page 41) "the power to accomplish" his "will . . . through the co-ordinated efforts of the several units of the command," then he passes, at the beginning of his career, from the military atmosphere of the Naval Academy, where he learned that the smallest units had military command over them, into the industrial atmosphere of the ship, where he himself has to handle all the details connected with the *elements* of the "squad" in his "group," when he should command the "squad" *commanders,* and *through* them command the elements of the "squads." But this will never become indoctrinated as the military relations of junior officer to petty officer, or of petty officer to man, so long as we continue to express, in marines on board ship, that the marines, only, are expected to have the military occupations and military relationships. Methods and customs instilled into an officer in early youth, are followed by him throughout his whole career.

This whole proposition of organization would seem to be so paramount, so fundamental, that until we have our navy organization on a simple military basis, all remedies proposed for ills growing out of incorrect organization will not bear the fullest fruit. Lieutenant King's prize essay for 1909 contains, in his unit idea, the germ of the ideally correct organization. Having arrived at a substantial homogeneity in our battleships and destroyers, there should be no trouble in reforming all the complements as to ratings—regarding certain differently named ratings in the sense of allied trades for simplicity's sake—and numbers, on the basis of a similar unit principle, with a probable decrease in total complement per ship. But with our vast number of ratings and trades, with our complicated and varying

ships' organizations, with the industrial spirit dominant everywhere, without a reasonable margin in the number of men allowed the establishment, there are, at present, almost insurmountable obstacles to any *military* organization so homogeneous as to afford us the soil in which to cultivate "unity of action." We should constantly aim for uniformity and simplification (amalgamation). Really we should aim to simplify Lieutenant Commander Knox's outline so as to merge "Ship departments" and "Ship divisions" into one. But standing in the way, we come against industrial relationships displacing military relationships. There is, on board ship, a peace time organization of departments and divisions which yields to the industrial needs, and it is in this relationship that officers and men, day after day, fall in at quarters, by divisions. Then, very occasionally, we break up the industrial organization and distribute men and officers into a battle organization in which we come into military relationships once a week —if we have the good fortune to have "general quarters" even once a week. Is it any wonder that naval industrialism dominates? Now when we amalgamate paymasters, we will not be hurting anybody's feelings to distribute and organize officers and men in the battle organization which will also be, as of course it should be, the day to day organization by which the military association of officers and men is kept foremost in their minds; something like this: The paymaster to command the *ammunition division*, the surgeon the *first aid division* (including stretchermen), the ordnance officer the *fire control and torpedo division*, the navigating officer the *ship control and signal division* (including radio communication), the first lieutenant the *repair division* (repair parties and deck parties), and the executive the *gun divisions*. In the ship organization at present the first lieutenant, the navigating officer, the ordnance officer and the paymaster, day by day, have little or no military relationship to the organization at all.

Incorrect organization based on industrial necessities is at the bottom of (page 48) "(2) Juniors lack proper elementary military instruction and fail to truly appreciate the *military* necessity for unqualified support of, and loyalty to authority. (3) There is lacking that mutual confidence . . . (4) The task of each person is not always clearly defined. . . .

That (page 52) "(c) *There is no well-defined doctrine of command—no codified set of rules governing the relations between seniors and juniors,*" is to a great extent the cause of an unfortunate tendency, yielding to the pressure of industrial necessities, toward obliterating the principles of "Rank, command and duty." In the Atlantic Reserve Fleet the battleships have run along under the nominal command of officers ranging in rank all the way from commander down to lieutenant; nominally, the executives range from lieutenant-commander to junior grade lieutenant; nominally, the senior engineers range from lieutenant to machinist. In our Monthly Navy List, one finds on recruiting duty, officers ranging in rank from captain to lieutenant; one finds on inspection duty under Bureau of Ordnance, officers ranging in rank from captain to gunner; one finds on inspection duty under the Bureau of Steam Engineering, officers ranging in rank from rear-admiral down to machinist.

The essayist's Rule VI is rather sweeping. We have had war games furnished to our wardrooms some years now, but experience shows that our life afloat is so strenuous that human nature, especially in youth, wants and needs relaxation from professional tasks. Youthful officers, while perhaps they should read Von Spohn on the Art of Command, might not be required to read Henderson and Vonder Goltz and Griepenkerl, and be made to attend ship meetings and discussions involuntarily. (The writer is sorry to admit that he has not yet caught up with all this excellent reading.) All the elementary principles of the Art of Command might be compiled into a midshipman's hand book and studied and applied on the practice cruises. Youth and middle age have different standpoints, different thoughts, different ideas, different aspirations, different recreations; this must be recognized in every organization whether civil or military. Ensigns and young lieutenants will get their training in "initiative" in their own spheres, provided the organization and system are once founded on military necessities. Middle aged officers should take all the essayist's rules well to heart, in order that this excellent doctrine should go into the spirit of the service, and thus be handed down. A military system will engender a desire to study military writers voluntarily, while the system of naval industrialism will continue as heretofore to breed the average young officer to regard the reading of military philosophy as irksome. But be that as it may, there are fine principles laid down by the essayist. His differentiation of "Orders" from "Instructions" is especially excellent; and it serves to point out, that "Instructions" for the juniors who should learn to handle details with service uniformity are best promulgated in "manuals"; and the time appears to have come when there is so much chaos as to warrant the promulgation of a manual covering the ordinary everyday life on board ship. "Different ships, different ways," is as old as the hills, and has been inseparable from naval industrialism. The essayist points out how wide these differences have become. *Should* these differences really exist in a *military* organization? They should not if we are to get "unity of action." They *will not* if we get on the *foundations* of a military organization; and the first step toward getting on a military foundation is to take the marines out of our complements.

LIEUT COMMANDER H. E. YARNELL, U. S. Navy.—Lieutenant Commander Knox, U. S. Navy, deserves great credit for having described in a clear and concise, and yet forcible manner, a condition of affairs which has existed in our naval service for a number of years.

The great body of American citizens are prone to regard adequate military preparedness as unnecessary, probably due to temperament and to the instruction received in youth from the so-called "histories" which omit all reference to defeats and national mistakes, and enlarge upon the victories.

It is needless to remark that such an attitude of mind should not exist in a corps of military men and it is probably true that most officers in the naval service are fully cognizant of its excellencies and deficiencies. Unfortunately the service is permeated with the national belief that all ills are cured by legislation, and that efficiency will result by act of Congress.

This is permissible when it can be truly stated that further increase in efficiency under existing conditions is not possible.

As but a short time has elapsed in our service since the initiation of a method of military instruction which was developed in Prussia, and put to the test of a successful war nearly half a century ago, it is reasonable to believe that a field exists for the increase of efficiency, which requires no additional legislation. No one can read this essay and believe otherwise.

The readiness for war of the naval service would be greatly increased if there existed in the country a number of competent civilian critics as is the case in Great Britain. But the greatest assistance of all would come from a more general understanding by the people of the United States of the true relations between national welfare and national defense.

This could be brought about in a generation by the introduction in our public school curriculum of the following books: "The Military Policy of the United States," by Upton; "Sea Power in its Relations to the War of 1812," by Mahan. There are others, but these are sufficient to indicate clearly the depths of humiliation and degradation experienced by our nation through lack of adequate preparation for defense.

In the meantime the naval service can do no better than follow the advice given by Admiral Mahan to the War College class in 1888: "I will sound again the note of warning against that plausible cry of the day which finds all progress in material advance, disregarding that noblest sphere in which the mind and heart of man, in which all that is God-like in man, reign supreme; and against that temper which looks not to the man but to his armor. And indeed, gentlemen of the Navy, if you be called upon some day to do battle, it will be for the country to see that your weapons are fit and your force respectable; but upon your own selves, under God, must you rely to do the best with the means committed to your charge. For that discharge you will be responsible, not to the country only, but to your own conscience; which will condemn you if, in the eager curiosity to know how your weapons are manufactured, you have neglected to prepare yourself for their use in war."

The essayist has clearly stated the necessity for and a method of making a broad step in this direction.

LIEUT. COMMANDER W. C. WATTS, U. S. Navy.—Lieutenant Commander Knox is certainly to be congratulated and thanked for his valuable essay on "Trained Initiative and Unity of Action," and it is believed that his scholarly presentment of the theories involved, and the pertinent historical precedents, will go far with all his readers toward remedying faults that have long existed in our service, but that only in comparatively recent years have been brought under scrutiny by the increasing complexities of naval warfare.

While considering that the analysis by the essayist of our present system of command is perhaps somewhat unduly uncomplimentary, there is no doubt that the majority of the summarized faults are to a great extent traceable to our lack of a more scientific and thoroughly understood code.

However, I do not think that it is a fair conclusion to blame the "spirit

of hostile criticism towards those in authority," set forth under (a), primarily on the present system, for this deplorable, yet recognized, frailty of human nature will inevitably rise to be combated by any system of command, and will thrive only in so far as inherent and perfectly apparent abuses of any system are permitted to exist.

Furthermore, although agreeing emphatically with the explanation of the harmful effects of the faults set forth under (d) and (e), I believe these are matters capable of correction without necessarily involving any radically new code of official life.

The fact that the United States is essentially a non-military country causes, I think, some need in peace time for a more highly centralized authority, particularly in the relations of the Department to the fleets, with us, than is required where opposition to the Navy is not so frequently encountered. If there were in this country a well-educated public understanding of the reason and needs of the Navy, and a cordial support by the legislative branch of the logical requirements for its development and efficiency, many of the present violations of a theoretically correct code of command would be easily eliminated.

This leads to the distinction that should be made between the relations existing *within* a fleet, and those between the Department and the very numerous officers in supreme command, afloat and ashore, all over the world, who look to the Secretary of the Navy for instructions. Although in some ways it appears as an anomaly, yet it is felt that great difficulty will be experienced in bringing these to a sufficient degree of similarity to permit of the application to both of the same rules. Any steps in the right direction in the fleet should certainly be enlightening to the Department, and official cognizance by the Secretary of the importance of the subject would assist throughout the service.

The broad subject of "the initiative of the subordinate" is really the keynote of the essay, and the labors of the Naval War College have brought this question to the careful consideration of many officers in recent years. Graphic representations, recitals of existing conditions, but above all actual failures in tactical and strategical games have impressed upon the students at recent conferences the importance of developing such intelligent initiative, yet the question always arises: "But how can we start?"

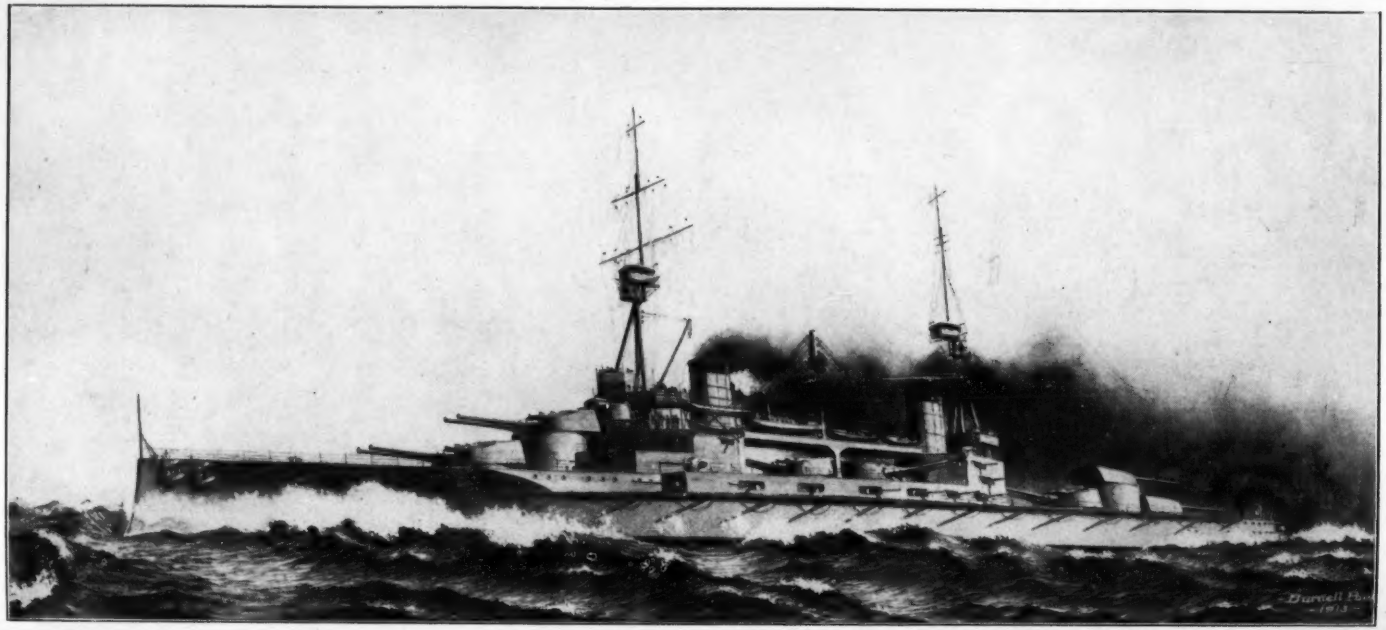
I was so fortunate as to be permitted to study some preliminary notes by the essayist on this subject about a year ago, and I then felt that the most *practical* step toward a uniform understanding of the duties of officers afloat would be a standardization of organizations on board ship, so that throughout the service the same conditions of responsibility for certain duties would be found. Numerous boards have been appointed and much good should follow.

After carefully studying the corrective measures suggested by the essayist, I am led to the opinion that the mere promulgation of a Departmental policy to adopt a certain doctrine, consisting of brief rules in general terms, of which the spirit of several may already be said to be in force, would not result in that intelligent cooperation essential to success. Without amplification, the reason for so unusual an order would not be understood

by the vast majority; and in some cases it would be resented as a "new fangled notion," as is sometimes the fate of other equally meritorious evolutions of science. In fostering regard for new principles, frank and open appeal to the reason of the masses has been found to be the most efficacious treatment; the same applies to the Navy, and I believe any effort to compel immediate adoption of a necessarily rather intangible and undescribable doctrine would jeopardize the ultimate success of this most highly desirable process of gradual evolution.

I would therefore prefer to see a pamphlet prepared to include very much the same matter as is found in the essay under discussion, but arranged in somewhat different form toward the end so as to avoid the semblance of iron-clad rules; this pamphlet to be issued to the service with the approval of the Secretary and with his earnest exhortation that all officers make their best efforts to effect the change with the least confusion. The great desirability of the matter could not fail to be apparent to all, if presented as admirably as is done by the essayist, and I think the service could be relied upon to work out its own salvation, under the exhortation of the Department, until, at some later date, when general opinion is well crystallized, it might be possible to cover the case with definite and precise orders.

As stated at the outset, but more emphasized by my later remarks, I feel that the wide circulation among the readers of the Institute of this excellent essay by Lieutenant Commander Knox will of itself do a great amount of good in spreading the doctrine that we all so much need, and that accordingly he is duly deserving of the thanks of all truly interested in the efficiency of the service.



BRAZILIAN BATTLESHIP "RIO DE JANIERO."

Drawn by Burnell Poole, member of the Naval Institute, from description and plans that appeared in PROCEEDINGS, No. 145, March, 1913, pages 362 to 365.

Digitized by Daniel Foole, member of the Naval Institute, from description and plans that appeared in Proceedings, No. 145, March, 1913. pages 362 to 365.

PROFESSIONAL NOTES.

Prepared by Lieut. Commander Ralph Earle, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Rivadavia.....	28,000	22.5	12 12-in., 12 6-in.	Fore River Co.	Launched Aug. 26, 1911.
Moreno.....	28,000	22.5	same	New York Co.	" Sept. 28, 1911.

These vessels are still much overdue, all of the 12-inch guns not yet being mounted. The Fore River Company on May 16 was reorganized and is now owned by the Bethlehem Steel Company. It will be known as the Fore River Shipbuilding Corporation.

AUSTRIA.

VESSELS BUILDING.

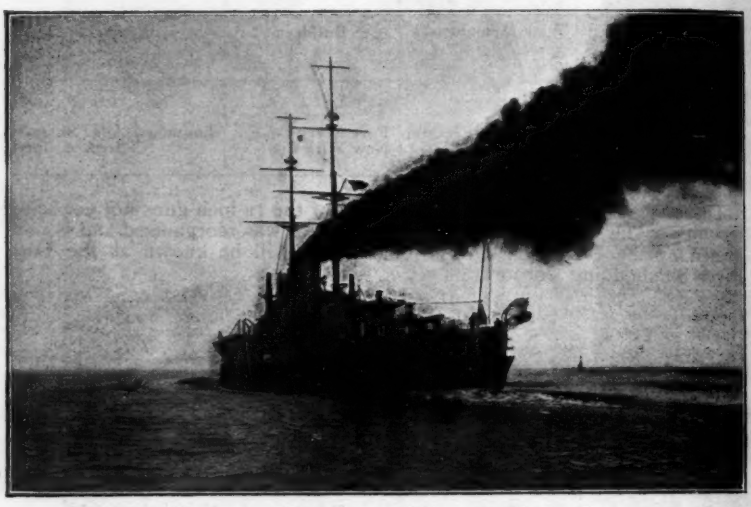
Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Tegetthoff.....	20,010	20	12 12-in., 12 5.9-in., 4 t. t.	Trieste.	Completing trials.
Prinz Eugen..	20,010	20	12 12-in., 12 5.9-in., 6 t. t.	"	Launched Nov. 30, 1912.
Schwartzenb'g	20,010	20	10 13.5-in., 12 5.9-in., 6 t. t.	Fiume	Laid down Jan. 29, 1913.
Ersatz Mon'ch	25,000	25	8 15-in., probably.	Trieste.	Designs in preparation.
" Budapest	25,000	25	same	"	same
" Wien....	25,000	25	same	Fiume.	same

The New Battleships.—Three dreadnoughts to replace the *Monarch* class, laid down in 1894, are to be commenced during the year. Much discussion has taken place relative to their characteristics. Admiral Hauss, well known for his scientific works and considered as one of the very best of the general officers of the Austrian fleet, is now the head of the navy since the recent resignation of Admiral Montecucoli, and is pushing the plans. The vessels are to be of 25,000 tons displacement, carrying 15-inch guns, with a speed of 25 knots.

"Viribus Unitis."—A further detailed description follows which combines all the information that has been made public.

This, Austria's first dreadnought, was built from the designs of the Chief Constructor, Sigfrido Popper, and executed under the direction of Naval

Constructor Teodoro Novotay, associated with Engineers Ginlio, Scarbert, and Givrannic Schlesinger. Laid down at the Stabilimento Tecnico Triestino in July, 1910, she was launched on June 24, 1911, and commenced her trials in August last year, having taken 26 months to build—an exceptionally short period, and one which will not be equalled by her three sisters. As was the case with the Italian ship, some errors crept into the calculations of her weights, but sufficient margin had been left to allow for any miscalculations, and consequently the increased displacement due to excess of calculated weight in her turrets has not influenced her draft, economies in weight having been made elsewhere. Her designed displacement is 20,000 tons, and she measures 525 feet over all, 89½ feet beam, and has a mean draft of 27 feet. The full-load weight works out at about 22,000 tons.



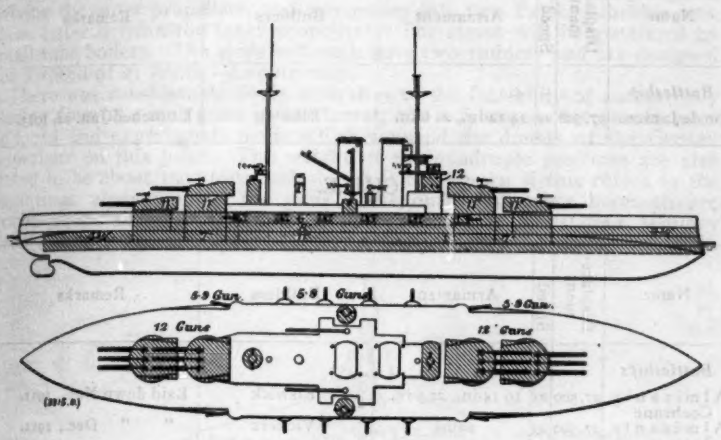
AUSTRIAN BATTLESHIP "VIRIBUS UNITIS."

The main 12-inch 45-caliber armament is disposed in four turrets with 11-inch armor, and each set of guns has a training arc of 300 degrees. Amidships, behind 6-inch armor, is the secondary battery of twelve 5.9-inch 45-caliber guns, of which the first and last are recessed to secure end-fire. On the top of each turret are three 2.8-inch 50-caliber quick-firing guns; four submerged 21-inch torpedo-tubes complete her offensive equipment.

These 12-inch 45-caliber guns weigh 54.3 metric tons, the projectile weighs 990 pounds, the indicated velocity is 2625 foot-seconds.

Amidships for about 160 feet the water-line belt is of 11-inch armor, continuing at 7 inches in thickness for another 50 feet fore and aft, and then thinning to 4¾ inches to the bow and to within a few feet of the stern. Above this is an 8-inch belt extending from the base of the first to No. 3 turret, and along the battery-deck there is 6-inch armor. The protective deck is from 1¾ to 2 inches thick. Forward there is a 12-inch armored conning-tower of huge dimensions, on top of which is the armored range-finder. Aft there is another armored position for these instruments, as well as one at each side amidships. In the three later ships the turrets are of 12-inch armor and the conning-tower of 14-inch armor.

Driven by Parsons turbines of 25,000 designed horse-power, the speed is 20 knots, steam being supplied by Yarrow boilers. On trial, 20.87 knots was averaged at full power. The normal coal supply is 900 tons, with 2000 tons maximum, plus oil fuel.



"VIRIBUS UNITIS."

Eleven searchlights are fitted, and 22 boats, two of which are motor-driven are provided. The ammunition supply for each of the guns is as follows: For 12-inch guns, 130 rounds per gun; for 5.9-inch guns, 200 rounds; for 2.8-inch guns, 2000 rounds.

The *Viribus Unitis* has cost $12,246,250.—*Engineering.*

THIRD SCOUT CRUISER.—The scout cruiser *Novara* was launched at the Danubius yard, Fiume, on February 15, having been on the stocks since November, 1911. This vessel is the third cruiser of the improved *Admiral Spaun* type, the two other representatives of the class, the *Saida* and the *Helgoland*, having been launched last October and November, respectively. The displacement is 3500 tons, and the turbines are designed to develop 25,000 indicated horse-power, giving a speed of 27 knots. Steam is produced from 16 Yarrow boilers. The vessel will have a complement of 300 men. Nine 50-caliber 4-inch quick-firing, two pompoms, and two deck torpedo-tubes comprise the armament. The normal coal supply is 450 tons; the maximum, 800 tons. Protection is afforded by a partial belt of nickel-steel 2½ inches thick, and a ¾-inch armor deck. The dimensions are: Length, 410 feet; beam, 42 feet; mean draft, 15 feet.—*Naval and Military Record.*

BUDGET.—The proposed sum for 1914 is $42,000,000. Of this, $1,800,000 is for the floating dock of 40,000 tons, $1,000,000 for submarines. This is the largest sum Austria has yet voted. The amount available for new construction is $15,976,100.

PERSONNEL.—Until this date there has never been in Austria a minister for the navy. The duties of such have been carried out by the Minister of War. Such a minister, and also a naval chief of staff, who will take the chief command in time of war, have been recently made.

BRAZIL.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleship					
Rio de Janiero	27,500	22	14 12-in., 20 6-in.	Elswick	Launched Jan. 22, 1913.

CHILE.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Almirante Cochrane	27,500	23	10 14-in., 22 5-in.	Elswick	Laid down Nov., 1911.
Almirante Latorre	27,500	23	same	Vickers	" " Dec., 1911.

CHILEAN DESTROYERS.—The vessels *Almirante Lynch* and *Almirante Condell,* built by Messrs. White & Co., of Cowes, are of 1850 tons displacement, 31 knots speed, propelled by three Parsons turbines, with 29,000 indicated horse-power, and are 320 feet long. Their cost is $5,000,000 each. The former held her trials in March.

FRANCE.

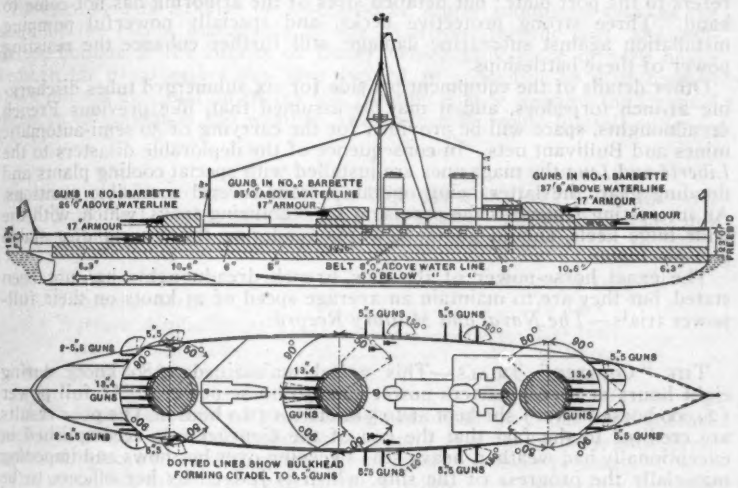
VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Courbet	23,500	21	12 12-in., 22 5.5-in.	Lorient	Undergoing trials
Jean Bart	23,500	21	same	Brest	same
France	23,500	21	same	St. Nazaire	Launched Nov. 7, 1912
Paris	23,500	21	same	La Seyne	" Sept. 28, 1912
Bretagne	25,000	21	10 13.5-in., 24 5.5-in.	Brest	" April 21, 1913
Provence	25,000	21	same	Lorient	" April 20, 1913
Lorraine	25,000	21	same	St. Nazaire	Laid down Nov. 7, 1912
Languedoc	25,200	21	12 13.5-in., 24 5.5-in.	La Seyne	" " May, 1, 1913
Normandie	25,200	21	same	St. Nazaire	same
Flandre	....	..	same	Brest	To be laid down Oct. 1, '13
Gascogne	....	..	same	Lorient	same

"NORMANDIE" CLASS.—These battleships are to be 574 feet in length, 88 feet 7 inches in breadth, with a displacement of 25,200 tons on a 28-foot 4-inch draft. The armament is to consist of twelve 13.386-inch guns, mounted in three quadruple axial turrets; twenty-four 5.512-inch guns in the central citadel; four 1.850-inch guns on the top of the latter in the center of the ship, two on each side; and six under-water torpedo launching-

tubes. A special subdivision of the ships by armored bulkheads will afford protection against submarine mines and torpedoes. Bullivant torpedo-nets are also to be carried. The ships are also to be fitted with an anti-rolling device. The propelling machinery will consist of two reciprocating engines driving the outer propellers, and exhausting into two Parsons turbine sets, these latter driving the inner propellers. The steam will be generated by small-tube boilers. The ships will each have two rudders and are designed for a speed of 21 knots.—*Engineering.*

There was considerable doubt at first as to the feasibility of successfully placing four 13.4-inch guns in one turret, but it is stated that proofs were adduced and experiments made which satisfied the doubts of the Conseil Superieur on this point. The weight of the quadruple positions are also stated to be about 1500 tons each, but it is not known if this refers to the mountings alone without the guns. The outline sketches herewith are drawn from sketches in the *Engineering* and *The Naval and Military Record* from plans supplied by French correspondents.



"NORMANDIE" CLASS.

The heights and arcs of fire are also shown upon the plans, to which the following details may be added: The diameter of each of the barbettes is about 31.7 feet, and, as they rise 14 feet above the deck, the superficial target of each turret is 434 square feet, or 1300 square feet total for the three positions. It is stated that the central barbette could, in case of necessity, fire over the aftmost turret, but it would appear by the plans that the narrow after-superstructure and the dwarf mast would be wrecked by the blast of the four central guns in such a case. The projectile of the 13.4-inch guns weighs 1190 pounds, the 5.5-inch shell weighing 81.57 pounds. The capacity of the magazines permits stowage for 100 rounds for each of the 13.4-inch guns and 275 rounds for each of the 5.5-inch guns. The twenty-four 5.5-inch guns are disposed at varying levels in groups of three, as in previous French dreadnoughts. They are as widely spaced as possible and well protected, so as to ensure the survival of at least two or three groups after an action against torpedo attack.

The armoring of the *Normandie* is of substantial and extensive nature. The main belt extends nearly the whole length of the water-line, except for a small portion near the stern, and this belt is 13 feet deep, 8 feet being

above the water-line, and 5 feet below the same. The thickness at the bow and stern is 7 inches, which rapidly increases to 10½ inches under the end barbettes. Amidships the belt still further thickens to a maximum of 12.6 inches. Over the main belt an upper strake of armor extends between the first and last barbettes for a length of 361 feet and a depth of 7 feet, the thickness of this upper belt being nearly 8 inches for a considerable portion of its length and thinning to 6 inches at the ends. The third and topmost strake of armor extends between the foremost and central barbettes and reaches to the upper deck level, being closed by bulkheads forming the citadel to twelve of the 5.5-inch guns. The foremost six 5.5-inch guns are disposed just before and below the forward four 13.4-inch weapons in an 8-inch battery, but it does not appear that the hoists to these six guns are protected. The armoring of the three barbettes is necessarily of a massive nature to reduce the chances of disablement, which would entail the loss of 33 per cent of the broadside fire and the whole of the fore and aft fire. The thickness of these barbettes is said to be 17.2 inches, which perhaps refers to the port plate; but detailed sizes of the armoring has not come to hand. Three strong protective decks, and specially powerful pumping installation against submarine damage, still further enhance the resisting power of these battleships.

Other details of the equipment provide for six submerged tubes discharging 21-inch torpedoes, and it may be assumed that, like previous French dreadnoughts, space will be provided for the carrying of 30 semi-automatic mines and Bullivant nets. In consequence of the deplorable disasters to the *Liberté* and *Jena* the magazines are installed with special cooling plants and flooding gear, the latter being operated from several accessible positions. An interesting feature is the provision for stabilizing tanks, which, with the wide bilge keels, should go far towards rendering the *Normandies* stable gun-platforms.

The exact horse-power of the new French dreadnoughts has not been stated, but they are to maintain an average speed of 21 knots on their full-power trials.—*The Naval and Military Record.*

THE "COURBET" TRIALS.—This vessel maintained 17.86 knots during eight hours at three-quarters power (21,250 horse-power). At full power (29,000 horse-power) she kept at 19.5 knots for two hours. The poor results are credited to the fact that the run of the *Courbet* was accomplished in exceptionally bad weather, heavy seas sweeping over her bows and impeding materially the progress of the ship, which is judged by her officers to be good for 20.5 knots at least in favorable conditions.

THE "JEAN BART" TRIALS.—During her 10-hour full-speed trial held early in May, she exceeded the speed of 21 knots attained on her preliminary trial and made a mean speed of 21.16 knots with 23 knots maximum. The three-hour speed trial held May 5 off the Glénans, Cherbourg, resulted in a speed of 22.04 knots. She thus becomes the fastest of the French battleships. She has Belleville boilers and Parsons turbines. The turret installations are like the English (for the first time in the French service) and are expected to develop a rate of fire equal to 2.25 rounds per minute.

DESTROYERS.—The Minister of Marine has caused the removal from the magazines of destroyers of all combustible material—wood, linoleum, paint, and cork.

THE MINE-LAYING VESSEL "PLUTON."—This vessel was launched by Augustin Normand, Havre, for the French Navy. The load displacement is 565 tons and the dimensions are: Length, 193.6 feet; breadth extreme, 27 feet; depth molded, 13 feet; draft, 10.2 feet. The propelling machinery

consists of two sets of triple expansion engines of 6000 horse-power, steam being supplied by two Normand multi-tubular boilers, giving a maximum speed of 20 knots, and 18 knots in service. The ordnance will consist of one 3-inch gun mounted on forecastle. The general appearance is that of a trawler, and the crew will consist of 5 officers and 42 men, all berthed forward, the stern being used exclusively as a mine magazine. The total cost is $365,327.—*Shipping*, Illustrated.

She and her sister ship, the *Cerbère*, will carry each 120 mines, which weigh 1210 pounds apiece, so disposed as to be in readiness for immediate laying through a stern tube.

SUBMARINES' ENDURANCE.—The Toulon submarine flotilla remained at sea for 60 hours, without one moment's relaxation, out of which they spent 24 hours below the surface.

DEFENCE OF THE STRAITS OF DOVER.—*The Matin* announces that, as the result of the recent maneuvers of the destroyer, torpedo-boat, and submarine flotillas in the Straits of Dover, which took place in very heavy weather, the naval authorities have decided, in opposition to their opinion of six months ago, that an enemy will have no chance to enter the Channel except in exceptionally bad weather, from which he would himself suffer.—*Reuter.*

SUBMARINE "MARIOTTE."—This was laid down in 1906, being the first vessel to call for Diesel motors of 1400 horse-power. The particulars of this vessel are:

Length	209.9 feet.
Diameter of hull	14 feet.
Surface displacement	530 tons.
Speed submerged	10 knots.
Speed surface	15 knots.

Two Diesel engines of 720 horse-power each give the high surface speed. The firm of Harlé undertook to build and finally have built these engines which are fitted with a cooling system of oil under pressure.

The vessel has taken five years in the building. Its habitability is better than usual and it has a large radius of action. It takes 25 seconds to submerge and has a radius of action of 2200 miles at 10 knots.

It is thought that no more large submarines such as this will be built, as the submersible has been adopted as the standard type.—*Le Yacht.*

BUDGET, 1913-1914.—Of the total of $89,028,626, the sum of $22,946,738 is for new construction. There are to be commenced two battleships, three destroyers, three submarines, and one river gunboat.

GERMANY.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Kaiserin.....	24,500	21	10 12-in., 14 5.9-in., 4 t. t.	Kiel (Howaldt)	Under trials off Danzig
Prince Regent Leopold	24,500	21	same	Germania Works	Launched Feb. 21, 1912
König Albert..	24,500	21	same	Danzig (Schichau)	" April 27, 1912
Grosser Kurfuerst	27,000	23	10 14-in. 4 6-in., 4 t. t.	Hamburg	" May 5, 1913
Ersatz Weissenburg	27,000	23	same	Bremen	Laid down Nov., 1911
König	27,000	23	same	Wilhelmshaven	Launched Mar. 1, 1913
Ersatz Brandenburg	27,000	24	8 14-in., 12 6-in.	Germania	Laid down Dec., 1912
Ersatz Worth.	.....	..	....	Kiel	To be laid down July, 1913
"T" 1913.....	.....	..	....	.....	.....
Cruisers of the Line					
Seydlitz.....	22,600	27	8 12.2-in., 12 3.4-in.	Hamburg	Undergoing trials.
Ersatz Kaiserin Augusta	28,000	30	8 14-in., 12 6-in.	Dantzig	Laid down Sept., 1912
"K" 1912.....	28,000	27	same	Hamburg	Laid down June, 1911
Ersatz Hertha.	.....		....	Wilhelmshaven	To be laid down July, 1913
Protected Cruisers		..			
Karlsruhe.....	4,900	28	12 4.1-in., 2 t. t.	Germania	Launched Nov. 11, 1912
Rostock	4,900	28	....	Howaldt	" Nov. 12, 1912
Ersatz Irene ..	4,900	28	....	Bremen	Laid down
" P. Wilhelm	4,900	28	....	Kiel (Kaiserliche)	" " Oct. 23, 1912

"KOENIG."—No absolutely reliable information is at hand, but such as is available states that Germany has in this class abandoned the echelon arrangement of turrets and placed the 14-inch battery all on the center in five double turrets protected by 14-inch armor.

"KAISER."—The battleship *Kaiser* is now officially described as the Imperial "Wohnschiff" (living-ship), in place of the *Deutschland*, so that in future the Emperor will take up his quarters in the new 24,000-ton armor-clad whenever he visits his fleet. The Imperial apartments in the older ship were furnished with great simplicity, and it is understood that most of the appointments have been transferred to the new "Wohnschiff" without alteration. It would be interesting to learn whether one particular work of art which used to adorn the *Deutschland* has been included in the removal. This was a large framed chart of the British Navy, illustrating every vessel of any fighting value, and had been drawn by the Emperor himself. Duplicates of this chart were presented to other ships in the High Sea fleet—one is still on view in the battleship *Preussen*—to be hung in the men's quarters. This tangible evidence of his Majesty's interest in naval matters, and the implied absorption of the Imperial mind with the fleet of the mightiest sea power, never failed to excite comment among foreign visitors. A few years ago these charts were constantly mentioned in the German service papers, which agreed that they had a very stimulating effect on the men.—*Naval and Military Record.*

GERMAN DREADNOUGHTS.—A Berlin correspondent, who forwards the following particulars of German dreadnoughts, writes that, "although not official, they are the most reliable to be obtained."

Name.	König.	Kaiser.	Helgoland.	Nassau.
Length feet	580	564	546⅔	478
Beam, feet	97	95¼	93½	88¼
Draught, feet	27¼	27¼	26 9/10	26½
Displacement, tons	26,575	24,312	22,441	18,602
Guns				
	10 14in.	10 12in.	12 12in.	12 11in.
	14 6.7in.	14 5.9in.	14 5.9in.	12 5.9in.
	12 3.4in.	12 3.4in.	14 3.4in.	16 3.4in.
Torpedo Tubes, all submerged:				
Broadside	4 21⅝in.	4 21⅝in.	4 21⅝in.	4 21⅝in.
Bow			1 21⅝in.	1 21⅝in.
Stern	1 21⅝in.	1 21⅝in.	1 21⅝in.	1 21⅝in.
Machinery	Turbine.	Turbine.	Triple Expansion.	Triple Expansion.
Designed H.P.	35,000	28,000	25,000	20,000
Designed speed	23 kts.	21 kts.	20.5 kts.	19.5 kts.
Coal, normal tons	1,476	984	885	885
Coal, maximum tons	3,937	3,543	2,953	2,657
Liquid fuel, tons	590	394	197	197
Screws	3	3	3	3
Boilers, naval type	18	16	14	12
Complement	1,150	1,073	1,106	963
Armor, Krupp:				
Belt, amidships	14in.	12in.	11in.	9¾in.
Belt, ends	5.9in.	4in.	4in.	4in.
Turrets	14in.	12in.	12in.	11in.
Battery	7⅞in.	6¼in.	5.9in.	5.9in.
Conning tower	16in.	15in.	14in.	12in.
Deck, on slopes	3in.	3in.	3in.	3in.

G. H. M.—*Naval and Military Record.*

DESTROYERS.—The tonnage of these from *V-1* to *G-12* is 690, and they carry three tubes with a battery of two 3-inch. The latest design, *S-13* to *S-18*, shows a displacement of 800 tons and a length of 269 feet, with a designed speed of 32.5, but it is reported that 35 knots was reached with horse-power of 23,000. They have two 3.6-inch guns, four 18-inch tubes. The six following, *S-19* to *S-24*, will reach a displacement of 1000 tons; will be lightly armored, and will have some under-water tubes.

SUBMARINE SERVICE.—The second flotilla of 12 submarines is nearly completed, the twenty-first vessel just having been launched. The two half flotillas in the service now have 38 line officers, 22 engineer officers, and 516 men. An increase of 248 men is provided for this year. The mother ship is the cruiser *Hamburg*, and two torpedo-boats, *D-5* and *S-99*, are attached to flotilla service. The *Vulcan*, salvage vessel, serves also as a training ship. The submarines frequently are attached to the High Sea fleet for exercises in the open sea. This use of them is being rapidly extended. A submarine station is to be built in Kiel harbor.

SUBMARINE CONSTRUCTION.—Eighteen vessels have been completed and there is reason to believe that this is due to the brilliant behavior of the sub- number is really greater. Those up to *U-18* are in service.

The Germans have followed the English lead and are arming their newest 800-ton submarines with two 14-pounder quick-firing guns on disappearing

mountings. These new submarines are to have armor protection over their vital parts, viz., the deck, the conning-tower, and that portion of the hull which is exposed when the vessel is awash. Coincident with the increased displacement the motor installation has been made much more powerful. Each boat will have two Diesel motors with a designed aggregate horse-power of 1800, giving a speed on the surface of 17 knots. The submerged speed will be 12 knots. It is understood that *U-21*, which was launched last February at the Danzig yard in an almost complete state, is the first representative of this improved type. The five Austrian submarines just ordered to be built at Krupp's Germania establishment will be of substantially the same type, but the displacement will be less, viz., 610 tons.

The Germans are thus going ahead rapidly with the submarine work and there is reason to believe that this is due to the brilliant behavior of the submarine boats which took part in the grand maneuvers last autumn. Their fine sea-keeping qualities and the ease with which they were able on several occasions to surprise and "torpedo" capital ships are said to have deeply impressed the Admiralty officials who witnessed the maneuvers. A noteworthy feature of the exercises was the comparative immunity enjoyed by the submarines even when delivering attacks in broad daylight, for from beginning to end only two boats were ruled out of action. Whether the periscopes fitted to German boats are much more efficient than those in use in other countries is not known. At all events, these boats seem able to maneuver with great precision when submerged, and to come to the surface at exactly the right distance from the ship to be attacked. The submarines rarely discharged their torpedoes at a range exceeding 400 yards, while more than once the distance was considerably less. Yet in hardly a single instance was their presence remarked by the object-ships in time to direct fire at them.

One day towards the close of the maneuver period the weather was bad, so bad, in fact, that the smaller destroyers were unable to do their part in the program, and had to run for shelter. A division of big cruisers belonging to the "blockading fleet" were patrolling some 20 miles off shore and keeping a sharp watch for one of the opposing battle-cruisers which was expected to make a dash to open sea. In view of the boisterous weather no one gave a moment's thought to torpedo attack, and a good many people on those cruisers got the surprise of their lives when half a dozen submarines bobbed up so close to them that torpedoes could not miss, and made the ominous signal that all four ships were torpedoed. But this, it is credibly asserted, was not an isolated case of the seaworthiness and the dexterous handling of submarines during the mimic war. They were found, moreover, to be less dependent than the surface torpedo craft on mother ships and shore bases for fuel and light repairs. If it be true, as is stated on good authority, that the 12 submarines which took part in the maneuvers "bagged" more big ships between them than fell to the 80 or 90 destroyers and torpedo-boats divided between the two fleets, then the decision of the authorities to develop the submarine branch with all possible celerity, both in regard to numbers and to the size and power of the units, is natural enough.—*Naval and Military Record.*

BUDGET, 1913-1914.—The estimates are $111,288,618. The personnel will be increased so as to be in 1913, 3394 officers and 69,495 men. The new ships to be laid down are two battleships, one battle cruiser, two protected cruisers, one gunboat, a flotilla of 12 destroyers, and an indefinite number of submarines, $4,760,000 being appropriated for these vessels.

PERSONNEL AND FLEET NOTES.—The retirement of Admiral von Holtzendorff from the command of the High Sea fleet on February 5, 1913, after serving an additional year upon the Emperor's personal wish, was

announced. Admiral von Holtzendorff's successor is Vice-Admiral von Ingenohl, who was appointed last summer, but temporary ill-health prevented him from assuming the command of the fleet at that time. The retiring commander-in-chief enjoys an unwonted measure of esteem and popularity in the service, where his never-failing kindliness and consideration endeared him to all ranks. He is credited with being a distinguished strategist and a firm disciplinarian. In appearance Admiral von Holtzendorff is a striking representative of the older school of German seamen, with his cheery, weather-beaten countenance and his Viking beard. Vice-Admiral von Ingenohl, who now hoists his flag in the *Friedrich der Grosse*, has served in the navy since 1874. For four years he commanded the Imperial yacht, and continued to act in that capacity even after his promotion to flag rank. From 1908 to 1910 he was in command of the China cruiser squadron, whence he passed to the control of the second squadron of the High Sea fleet. He is popularly supposed to be a brilliant exponent of up-to-date gunnery principles.

NAVAL STATIONS.—Wilhelmshaven is gradually superseding Kiel as the leading naval station. There are 10,695 employees at the former place and 10,468 at the latter. Kiel is still the leading repair station.

Vice-Admiral von Ingenohl uses his flagship, the *Friedrich der Grosse*, as the fleet flagship maneuvering outside the formation, as is the case in our service with the *Wyoming*.

Only one large vessel in the German fleet is now in reserve, the *Wittelsbach*.

Other vessels of the main battle fleet are assigned as follows:

First Squadron.—Vice-Admiral Lans, Rear-Admiral Trummler. *Ostfriesland, Thuringen, Helgoland, Oldenburg, Posen, Rheinland, Nassau, Westfalen.*

Second Squadron.—Rear-Admirals Scheer and Souchon, with the *Preussen, Pommern, Hessen, Lothringen, Hannover, Schlesien, Schleswig-Holstein, Deutschland.*

Third Squadron (not yet to full strength).—Rear-Admiral Schmidt with the *Kaiser, Braunschweig* and *Elsass.*

Scout Cruisers.—Vice-Admiral Bachmann, Rear-Admirals Hipper and Frenke, with the battle-cruisers *Moltke, Gœben, Von-der-Tann* and *Yorck*, and ten cruisers, *Coln, Stralsund, Stettin, Kolberg, Dresden, Mainz, Breslau, Strassburg, Hela.*

China Squadron.—Rear-Admiral von Spee, with *Scharnhorst* and *Sneisenau, Nurnburg, Leipzig, Emden*, four gunboats, three river gunboats and two torpedo-boats.

THE SINKING OF TORPEDO-BOAT "S-178."—On the night of Tuesday the 4th of March, the German torpedo-boat *S-178*, whilst returning from night maneuvers, was struck by the cruiser *Yorck* a few miles off Heligoland and practically cut in two. She sank almost immediately, carrying nearly 70 of her crew to the bottom with her.

Until very recently it was not customary in the German Navy to engage in sea exercises on a grand scale before April. This disaster comes as a reminder that the old policy no longer holds, and that nowadays the German fleet carries out its work at all seasons, irrespective of weather. In the maneuvers which terminated so fatally on March 4 the whole of the First Squadron was engaged, including eight battleships and six cruisers. The ships had been at sea since the previous day.

The waters adjacent to Heligoland have now become the favorite exercising ground for the First Squadron, and with the approaching completion of the torpedo and submarine harbor the island itself is developing into an important naval rendezvous. While at sea the fleet keeps in touch with the

mainland by a tender service daily between Heligoland and Wilhelmshaven. One result of the new policy of incessant training at sea is that the North Sea base is frequently denuded of large ships. Contrary to past procedure, men-of-war are not encouraged to lie up in harbor, but are sent to sea and kept there on every possible occasion.

The destroyer, under command of Senior Lieutenant Pies, a particularly efficient officer, was attached to the eleventh half flotilla belonging to the reserve flotilla of the torpedo division of the North Sea Station. In these so-called reserve divisions the crews consist of men in their third year of service. These third-year men are regarded as having finished their training, and although variously employed, the reserve flotillas are only called out at intervals for surprise maneuvers.

It appears that the eleventh half flotilla was mobilized on March 3 for maneuvers in the North Sea with the first battle squadron and the cruisers of the High Sea fleet. In stormy weather, on the night of March 4, maneuvers were carried out somewhere to the north of Heligoland. These were concluded at about 11 p. m., when the cruisers and destroyers, all displaying their navigation lights, were ordered to proceed to their anchorages off Heligoland. The eleventh half flotilla was leading, but destroyer *S-178* dropped astern of the rest by some hundreds of yards. The official account says that she tried to cross the bows of the large cruiser *Yorck*, and to this the collision is attributed.

The plain fact seems to be that the destroyer at a critical moment failed to answer her helm, and was literally hurled against the ram of the armored cruiser *Yorck* on the crest of a great wave. As both the cruiser and the destroyer were steaming very slowly, this explanation would account for the force of the blow which cut the latter craft nearly in two. So tumultuous was the sea that the destroyers were practically unmanageable, notwithstanding that all of them are of relatively big displacement, the *S-178* being of 636 tons. In weather like this steering is bound to be somewhat erratic, and a distinct element of danger is present when boats are maneuvering in the vicinity of large ships. The catastrophe itself has naturally overshadowed the events which followed immediately afterwards, but from all accounts the crews of the other destroyers and the cruisers displayed superb courage and coolness in the work of rescue. The lost boat had her full complement of 83 on board of whom 13 were picked up after the collision.

The extremely heavy loss of life which accompanied the sinking of the destroyer *S-178*, off Heligoland characterizes this disaster as one of the worst in the history of the German Navy.

The loss of 70 officers and men—in itself a serious blow to the navy—is accentuated by the fact that nearly all the men who met their deaths were in their third year of training, and thus had become highly trained. The sunken destroyer belonged to the very pick of the North Sea division. Nominally in reserve at Wilhelmshaven, the eleventh semi-flotilla is actually ready for operations at an hour's notice, as are each of the other 13 semi-flotillas which now constitute the torpedo division at the North Sea base. Wisely recognizing that the ships in Wilhelmshaven will most probably be those on whom the first brunt of war will fall, the Navy Department has lately made a practice of including among their crews a larger percentage of highly-trained men than find a place in the Baltic ships, and this is particularly the case as regards the torpedo division.

The *S-178* was one of a batch of four destroyers built by Schichau under the 1909 programme, the remaining eight of the same programme being built at the Vulkan and Germania yards respectively. She was fitted with Schichau turbines, which developed 16,000 shaft horse-power, and gave her a speed of 32 knots, somewhat exceeded on trial. Her equipment and torpedo armament were of the latest pattern.

GREAT BRITAIN.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Ajax	23,500	21	10 13.5-in., 16 4-in.	Scott (Greenock)	Under trial May 14 to 21
Audacious	24,000	21	same	Cammel Laird (Birkenhead)	Launched Sept. 14, 1912
Benbow	26,000	22	10 13.5-in., 16 6-in.	Beardmore	Laid down May 30, 1912
Delhi	26,000	22	same	Vickers	" May 31, 1912
Iron Duke	26,000	22	same	Portsmouth	Launched Oct. 12, 1912
Marlborough	26,000	22	same	Devonport	" Oct. 24, 1912
Qu'n Eliz'b'h	27,000	25	8 15-in., 16 6-in.	Portsmouth	Keel laid Oct. 21, 1912
Warspite	27,000	25	same	Devonport	" " " 31, 1912
Valiant	27,000	25	same	Fairfield	Laid down Jan. 31, 1913
Barham	27,000	25	same	Brown & Co.	" " Feb. 24, 1913
Battle Cruisers					
Queen Mary	28,850	30	8 13.5-in., 16 4-in.	Palmer	Under trial May 30–June 5
Tiger	28,850	25	same	Brown & Co.	Laid down June 20, 1912
Australia	18,750	25	8 12-in., 16 4-in.	"	Commissioned
Light Cruisers					
Nottingham	5,400	25	9 6-in., 4 3-pdrs.	Pembroke	Launched April 18, 1913
Birmingham	5,400	25	same	Elswick	" May 7, 1913
Lowestoft	5,400	25	same	Chatham	" April 23, 1913

"CENTURION."—After rather extensive repairs, necessitated by the collision with the *Derna*, the *Centurion* was commissioned on May 22. This battleship and the others of her group possess the most complete fire-control system yet fitted, each barbette having its own range-finding set of instruments in addition to the masthead fittings. They include the newly designed armored fire-director tower at the masthead, in which will be installed the set of instruments which may be said to have practically revolutionized long-range fire, rendering possible either broadside, salvo, or independent fire to be controlled and directed with unerring accuracy at all ranges. As this mast will have to afford the principal support to the lofty aerial wires, a new design of rigging has been adopted, six insulated legs taking the place of the four previously fitted, thus affording a rigid support at all angles. Duplicate platforms have been attached to the mast at lower elevations for observation purposes, having electrical connection with the fighting positions. The additional central athwartship bridge, with fore and aft wings and raised searchlight projector platforms near the after funnel are now nearing completion, and are the first of their kind to be fitted in our dreadnought units. They enable the four central searchlights to be aligned on either broadside.

Duplications of important fittings are a special feature of the *Centurion's* equipment, and, assuming the entire mast wrecked by shell fire, it would be still possible to efficiently fight the ship, as the main conning-tower and each barbette has its complete installation of range-finding and control appliances.

Speed attained on trial was 22.9 as a maximum, with 22 knots the mean for an eight-hour run off Polperro.

"AJAX."—Is carrying out her trials under the command of Sir Arthur J. Henniker-Hughan, who is 47 years of age. The result of her four-fifths power 30-hour trial was very satisfactory, the contract horse-power being exceeded.

ALTERATIONS.—The *Temeraire, Collingwood, Thunderer* are having various alterations made, such as larger masthead fire-control platforms, duplicate ranging instruments, new armored casemates for intermediate battery, light armor on crowns of the magazines, wider bilge keels, stiffening the fire-control mast by a probable return to the tripod type.

"BENBOW."—Her dimensions are as follows:

Length between perpendiculars	580 feet.
Beam	89 feet 6 inches.
Mean load draft	27 feet 6 inches.
Displacement at load draft	24,000 tons.
Designed power of turbines	33,000 S. H. P.
Designed speed	22 knots.
Coal capacity	3,000 tons.

Armament.—Ten 13.5-inch guns and sixteen 6-inch guns.

The ship is 90 feet longer, has 7 feet 6 inches more beam, 1 foot greater draft and 6000 tons greater displacement than the *Dreadnought*.

The main propelling machinery consists of two sets of Parsons steam turbines designed for 33,000 shaft horse-power. Each set consists of one high-pressure ahead and one high-pressure astern, and one low-pressure ahead and astern combined turbine. The turbines are arranged in three water-tight compartments; one high-pressure ahead and one high-pressure astern, fitted to the same shaft, are arranged in the outer compartments and both low-pressure in the center compartment.

All of the turbines are controlled from the center engine room and connections are arranged so that, in the event of either or both side engine rooms being disabled, the ship can be driven with only the low-pressure turbines. There are four shafts, each fitted with a solid bronze propeller.

The main condensers are arranged in the center engine room, one for each set of turbines. They are of the Weir Uniflex type, and the large circulating pumps of Allen's centrifugal type are fitted to each. Two of Weir's Dual air pumps are also fitted to each condenser.

A complete system of forced lubrication has been installed for the supply of oil to the turbine and shaft bearing blocks. Powerful overhead travelers are arranged on girders on the underside of the lower deck, over each shaft, for lifting the upper half of turbine casings and the turbine rotors when necessary.

The usual auxiliary machinery is provided. Powerful steering engines in duplicate are arranged in the engine room, connected by means of shafting and gearing to the rudder heads and controlled from the steering positions by telemotor gear. An auxiliary condenser, evaporator and distilling plant feed pumps, fire and bilge pumps, oil fuel pumps, and forced draft fans are also fitted. There are also air compressors for torpedo service, and hydraulic pumping engines for the gun machinery and the hydraulic boat hoists. A steam-driven capstan and windlass is fitted forward and several electric coal-hoisting winches are placed on deck.

Steam is supplied by an installation of 18 Babcock & Wilcox boilers. They are of the latest type, designed for burning coal and oil fuel, and are arranged in three water-tight compartments.

As regards the armor for the ship, it extends for practically the full length of the hull, being 11 inches thick from about 5 feet below the water-line to near the upper deck, while the top strake of armor is 9 inches thick. Toward the stem and stern the thickness is reduced. Heavy armored bulkheads extend across the ship at the forward and after ends of the thick side armor, in order further to protect the barbettes, which are of 12-inch armor. The conning-tower is also constructed of 12-inch armor.

Like all the previous dreadnoughts, the *Benbow* has a high forecastle, so that the forward 13.5-inch guns are mounted at a great elevation. All the

guns are mounted in pairs on the center line of the ship, this arrangement giving a broadside fire of 10 guns, an ahead fire of four guns and a fire astern of four guns. The anti-torpedo boat armament of the *Benbow* is a novel feature. There are 16 guns, as in all the earlier super-dreadnoughts, but they are of 6 inches instead of 4 inches caliber. The adoption of the 6-inch gun is a reversion to the idea of secondary armaments. The ship has three submerged torpedo tubes, each capable of firing 21-inch torpedoes, and to protect her from torpedo attack there are torpedo defence nets all fore and aft.

The propeller shafting passes through the ship's hull, and each shaft is carried in stern struts of the *A* type. The two rudders are of the balanced form, unsupported outside of the hull, the weight of each rudder being carried on the lower deck.

In outward appearance the *Benbow* resembles the *Dreadnought*, having two stacks and one mast.—*International Marine Engineering.*

"WARSPITE."—The construction of the battleship *Warspite* at Devonport dockyard, as the result of nearly six months' labor, has been well advanced, the progress during the past month having been particularly praiseworthy.

The lines of the hull appear to be as fine as those of an Atlantic liner until they broaden out into the center section, which is greater in width by two feet than any previous battleship; then after continuing in straight lines for several hundred feet, the hull curves inward, and when the stern section is in place the lines will taper in a lengthened wedge shape.

A broadside view of the hull gives the impression that by a combination of the battleship and battle cruiser characteristics the ideal fast battleship has been evolved.

The battleships of the *Warspite* class are now sufficiently advanced to make it clear that they will mark a distinct advance on their immediate predecessors, the *Iron Dukes*. Their displacement will be about 27,000 tons, or 2000 more than the *Iron Duke* class, and in general characteristics they will have much of the battle cruiser about them. Thus they will have engines of 60,000 horse-power, which should be ample to enable them to reach their designed speed of 25 knots. On the other hand, they will have the protection of battleships, a belt of 13.5 inches being mentioned. Last, but not least, they will be armed with guns heavier than those of any ship yet laid down, except the Japanese battleship *Fuso*, which is credited with ten 15-inch weapons of the same caliber as those of the new British vessels. Partly on account of weight, and partly in order to facilitate a better distribution of the secondary armament of sixteen 6-inch, there will be only eight 15-inch guns mounted in the *Warspite* class, as in the case of battle cruisers. The Vickers' 15-inch gun weighs 96 tons, as against a weight of about 76 tons for the 13.5 inch, and fires a shell of 1950 pounds, compared with 1400 pounds for the guns of the *Iron Duke*.

"QUEEN MARY."—Will commission in June, 1913, under command of Captain William R. Hall, who is 43 years of age.

H. M. S. "NOTTINGHAM."—Her first keel-plate was laid on June 13, 1912, and she is expected to be completed in March, 1914. Her principal dimensions are: Length, 430 feet; extreme breadth, 49 feet 10 inches; mean load draft, 15 feet 10 inches; and displacement 5440 tons. The vessel will be protected by side armor consisting of an outer belt of nickel steel and an inner belt of high-tensile steel, of a maximum thickness of 3 inches, and in addition her decks will be formed of thick, high-tensile steel plates. A considerable degree of protection will thus be afforded to the machinery spaces, magazines, and other vital parts of the vessel. The propelling machinery, provided by Messrs. Hawthorn, Leslie & Co., of Newcastle, will consist of twin turbines, developing 25,000 horse-power, giving the vessel a speed of

25.5 knots. There will be 12 Yarrow water-tube boilers, four in each of three stokeholds, and four funnels. In addition to coal bunkers with a maximum capacity of 650 tons, she will have accommodation for oil fuel. The main armament will include nine 6-inch guns and two 21-inch torpedo tubes. The complement will number 400 officers and men.—*Page's Weekly.*

SCOUTS.—The cost of re-arming and re-fitting the eight scouts or "light cruisers" so as to bring them up to date and render them capable of taking the offensive against modern destroyers is officially estimated at $1,400,850. The scouts were completed for sea eight years ago, and with $10,645,500. The vessels were paid off in August last to be mounted with nine 4-inch quick-firing guns. The armament of 12 of the destroyers built under the naval programme of 1911-12 (three of which have been delivered) consists of three 4-inch breech-loading guns, whilst the remaining eight are to be equipped with three 4-inch quick-firing guns. The offensive power of the scouts in guns will, therefore, be treble that of the latest destroyers, but the new destroyers will have the advantage in speed; those laid down under the 1911-12 programme having been designed to steam at speeds varying from 29 knots to 31 knots, whilst the speed of the eight scouts varies from 25.48 knots of the *Pathfinder* to the 24.86 knots of the *Skirmisher.* The refits of six of the eight scouts have already been commenced, the *Pathfinder, Sentinel* and *Skirmisher* at Portsmouth, the *Patrol* at Haulbowline, and the *Adventure* and *Attentive* at Devonport. The *Foresight* and *Forward* will shortly be commenced at Chatham dockyard.—*United Service Gazette.*

DESTROYERS.—A comparison between the average destroyers of the British and German navies shows the following important points:

Some 30 per cent of British vessels are older than the oldest of Germany's, whose destroyers, taking an all-round average, are nearly three years "younger" from the date of launch than the British.

British vessels are superior in size, and roughly equal—striking an average—in speed.

They largely excel the German boats in gun power, but the torpedo equipment of the average unit is considerably below that of the German.

Germany's vessels have a greater fuel capacity, but the use of oil in our later types gives them a radius of action at least equal, and probably greater.

MINE LAYERS AND TRAWLERS.—An armament to protect these against destroyers is to be fitted. The "Trawlers' Reserve," an admirable body of men has been assembled by the Admiralty for the purpose of manning the trawlers, the mine layers being manned by general service men with some specially trained torpedo men. The officers who are to have charge of these vessels in time of war have all been carefully selected and are experienced men in the work. The vessels have headquarters at various points along the coast.

COALING ACCIDENTS.—A White Paper, giving particulars of the more serious accidents which occurred during the coaling of his Majesty's ships in 1910, 1911, and 1912, shows that on 27 occasions death or injury was caused. During the three years two midshipmen and 14 petty officers and men have been killed, and two lieutenants and 21 petty officers and men injured.

BUDGET, 1913-1914.—The actual sum voted by Parliament in February was $224,140,000, an increase over the past year of $5,950,000. This includes about $5,000,000 of 1912 budget that was unspent, work on several vessels having been much delayed. In addition to this sum voted the Admiralty has many other sums; one, called "appropriations in aid," amounts to $2,010,000 this year, and is received from India and the dominions. The *actual sum to be spent on the navy will be $233,940,000.*

Yet the English service papers say, "The new programme is not ambitious." Let us see what it amounts to: Five battleships, eight light cruisers, sixteen destroyers, and a group of submarines.

It is claimed by the press that six battleships at the least should have been provided for.

The actual number of submarines to be built is not given, but as a much larger sum is to be taken this year, an increase in the number of vessels is probable. The total of $15,326,000 for submarine construction is provided for, a huge increase over last year. Bigger and more vessels probably.

On April 1, 1913, Great Britain had under construction 10 battleships, 2 battle-cruisers plus the *Australia*, 12 light cruisers plus the *Sydney*, 35 destroyers, and 21 submarines (2 being for Australia).

Two of the new battleships will be built in the Portsmouth and Devonport dockyards and three in private yards. Light cruisers are to be built: Two at Pembroke, one at Chatham, and five at private yards.

No details of the new battleships are available, ten 15-inch being stated as the probable main battery.

Engineering criticises the lack of provision for air craft on the ground that they cost little and much can be learnt from them.

The personal increase is 8500; the maximum personnel, as provided for, being 146,000. The increase is in the following ranks and ratings:

Flag officers	1
Commissioned officers	5377
Petty officers and seamen	4622
Boys	2643
Coastguard	30
Royal Marines	900

The increased strength in the Royal Marines is due in part to the intention to man the defence in Cromarty Firth with this corps.

In the estimates no sum is definitely set aside for aeroplanes, hydroplanes, or dirigibles, although for the accommodation of such craft $484,000 is allotted.

The outlay for oil fuel depots is large, approximately $5,000,000. Depots at Humber, Medway, Portsmouth, Rosyth, and Invergordon.

NOTES ON THE BUDGET.—It appears to be very certain that oil for fuel in the British Navy will supplant coal entirely in a very short time. Five battleships, eight armored cruisers and sixteen destroyers in the 1913-14 programme will burn oil to the exclusion of coal. The Admiralty is already spending about $10,000,000 in equipping the fleet with shore and seagoing oil fuel depots, and is also active in experimenting with internal combustion engines, one of which, the invention of an English officer, is said to give twice the horse-power per unit compared with any other engine in existence. The Admiralty, it is understood, has decided that all future warships shall be driven exclusively by oil fuel.

But the most interesting change will be found in the programme of torpedo craft. The destroyer is to disappear. In her place submarine torpedo craft will be built, which will far exceed the *E* and *F* class in power. They will, in fact, be destroyers capable of submersion, and, therefore, available for attack both by night and day. The details are as yet a secret, but it is safe to say that these craft will have a surface speed approaching that of the *River* class of destroyer, *i. e.*, 25.5 knots, that they will be well armed with quick-firing guns, and will have a greater radius of action than any destroyer afloat.

In addition to these, it is proposed to build a certain number of small submarines for the purpose of coast defence. They will be of about the size of the *A* class, but will embody numerous improvements in offensive power.

The development of air craft has not been overlooked in the plans of the Admiralty. In addition to their main armament the new battleships will carry not only 6-inch guns but also 3-inch, disposed behind armor, and mounted in such a way that they may be available for use against attack from the sky.

The battleships will be vessels of about 28,000 tons, with an armor belt of 13½ inches, a legend speed of 25 knots, and an armament of eight heavy guns, 15 inches or 16.25 inches. The amalgamation of type has been long approaching. Next, there will be eight light-armored cruisers, about 300 tons heavier than those laid down last year. These will be armed with four 6-inch and eight 4-inch guns.

CANADA'S PROJECT.—The lower house of the Canadian Parliament voted $35,000,000 for the construction of three dreadnoughts by a majority of 32 in a session full of patriotism. The upper house, however, rejected the proposal stating that the people as a whole should vote on this.

THE PROGRAMME OF CONSTRUCTION.—Mr. Churchill has now definitely pledged the government to build 25 super-dreadnoughts to the 14 super-dreadnoughts which will be laid down under the six-year programme of the new German Navy Law. This is in a ratio of 18 to 10, and it takes no account of the ship presented by the Federated Malay States or the vessels which Canada proposes to give.

DOCKS.—A new lock, which can also be used as a dry dock, for ships of the super-dreadnought class, was brought into use on April 7, 1913, at Portsmouth dockyard, which for some years has been severely handicapped in the matter of docking accommodation for ships of the dreadnought class. With the exception of the floating dock which was delivered at that port a few months ago, there was only one dock at Portsmouth in which a dreadnought could be placed, and ships could only be got to that one at certain states of the tide. This difficulty has been overcome by the provision of the new lock, which provides a passageway for ships of the largest kind from the harbor into the large basins. The lock or dock is nearly 900 feet long, 110 feet wide at entrance, with a depth of water of 33 feet at the entrance at low water ordinary spring tides, and 46 feet at high water. Pumping machinery has been provided which is capable of emptying the dock in four hours. The lock, which has taken close on four years to complete, has cost £1,000,000 sterling. Another lock of similar size is being constructed alongside of it, and that will be ready for use in about a year's time.

ADMIRALTY POLICY OF ARMING MERCHANTMEN.—British merchant ships are in future to be armed, the Admiralty lending guns, supplying ammunition, and providing for the training of members of the ship's company to form the guns' crews, while the owners meet the expense of the necessary structural alterations. The first ship to be thus equipped is the Royal Mail Steam Packet Company's *Aragon*. She has been equipped with two 7.4-inch guns, and during her voyages to this country from Argentina with chilled meat she will be no longer at the mercy of any foreign ship which, hoisting the national flag while still at sea, instantly converts herself into an armed ship. The same company's *Amazon* is also going to be provided with guns, and before many months have passed there will probably be quite a number of British steamships thus protected.—*Naval and Military Record.*

PERSONNEL.—The following is the present state of the flag list, and it will be observed that less than 47 per cent of the officers are usually employed:

Rank	No. allowed	No. usually employed
Admiral	12	5
Vice Admiral	22	11
Rear Admiral	55	25

Less than five years ago promotion to flag rank became so rapid that the Admiralty deemed it desirable to obtain Orders in Council to specially promote several captains who had not served for the requisite very short period required by the King's Regulations to qualify for promotion, viz., six years' service, of which three must have been in a ship of war at sea.

Promotion to flag rank at an early age is of no use to an officer unless he is a man of means, and does not care whether he is employed or not, or is in the swim (it used to be called the fish pond), and is likely to be constantly employed. A few examples will show what is meant:

Admiral the Hon. Sir Edward Meux reached the rank of rear-admiral at the age of 46 years and three months, and should he live to the age for compulsory retirement will have served for less than nine years during the 23 years and nine months he will have been on the flag list.

United Service Gazette.

ADMIRAL SIR PERCY M. SCOTT, BART., K. C. V. O., K. C. B., LL. D.

Vice Admiral Sir Stanley Colville reached the rank of rear admiral at the age of 45 years and nine months, and if he lives to the age for compulsory retirement will possibly have served for eight years out of the 24 years and three months he was on the flag list.

Rear Admiral David Beatty reached that rank at 39 years of age, and should he live to the age for compulsory retirement may possibly have served for nine years out of 31 years he was on the flag list.—*Naval and Military Record.*

ADMIRAL SCOTT.—Vice Admiral Sir Percy Scott retired on March 20, 1913, upon his promotion to the grade of Admiral. Although not a usual custom with the PROCEEDINGS, in view of his direct influence in furthering the efficiency of our service, a sketch of him is given. He was born on July 10, 1853, and entered the navy in August, 1866. His first service as a gunnery officer was on the *Inconstant* in 1882. He served prominently in all grades and was made a captain January 1, 1893. His first duty in command of the *Scylla* was marked by the ship making a world's record in gunnery.

On the *Terrible* he took a 4.7-inch to the relief of Ladysmith, landed 12-pounders at Taku during the Boxer Rebellion, transporting them to Tien-Tsin and Pekin. In 1900 and 1901 the *Terrible* made remarkable gunnery records. He was in charge of the gunnery school at Portsmouth, 1902-1905. On February 24, 1905, he became the Inspector of Target Practice, a new position. In July, 1907, he took command of the first cruiser squadron. December, 1910, he became a Vice Admiral.

The *United Service Gazette* says:

"It may truly be said that no officer has ever devoted his talent to greater advantage to the navy, and, consequently, to the Empire, than Sir Percy Scott, for the greater part of his career has been spent in inventing and introducing improvements in the gunnery efficiency of the British Navy, and the results which he has obtained have been little short of startling. For a long period the attention of the Admiralty had been mainly concentrated on the multiplication of 'keels,' the training of the gunners, in whose hands largely lie the issues of victory or defeat, being relegated to a subordinate position. Within the area of his own personal influence, at first, Sir Percy Scott altered all this. He revolutionized the methods of training the blue jacket how to handle his gun to the best advantage. At the end of last century target practice in the British fleet was at low ebb, the general percentage of hits being as low as thirty-one. Within a short time, by the adoption of the Scott methods, the percentage was raised to eighty, and more recently it has risen even above that high point."

ITALY.

VESSELS BUILDING.

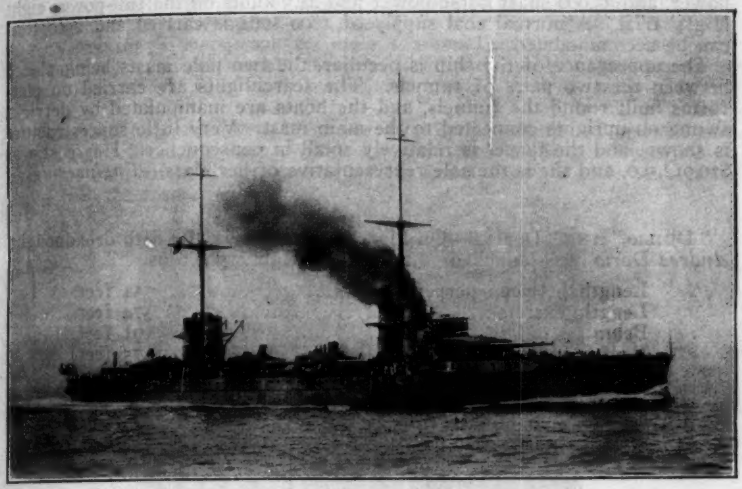
Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Cavour	22,000	22	13 12-in., 18 4.7-in.	Spezia	Launched Aug. 10, 191
Giulio Cesare	22,000	22	same	Ansaldo-Armstrong	Undergoing trials
Leonardo da Vinci	22,000	22	same	Genoa (Odero)	Launched Oct. 14, 1911
Andrea Doria	22,400	23	13 12-in., 16 6-in.	Spezia	Launched March 30, 1913
Duilio	22,400	23	same	Castellamare	" April 30, 1913
Dandolo	28,000	25	10 14.2-in., 26 6-in.	Ansaldo	Laid down Dec., 1912
Morosini	28,000	25	same	Odero	" " Dec. 1912

"DANTE ALIGHIERI."—A description of this vessel more in detail than has been given before follows:

The *Dante Alighieri* was laid down at Castellamare on June 6, 1909; launched on August 20, 1910; and first commissioned on November 11, 1911, for trials, which were completed in June last year. Her dimensions are: Length over all, 550 feet; beam, 87¼ feet; and mean draft, 28½ feet, giving a normal displacement of 19,400 tons. Owing to some miscalculation in the initial designs, it is officially admitted that her designed draft has been exceeded by 16 inches. The original displacement was 18,302 tons.

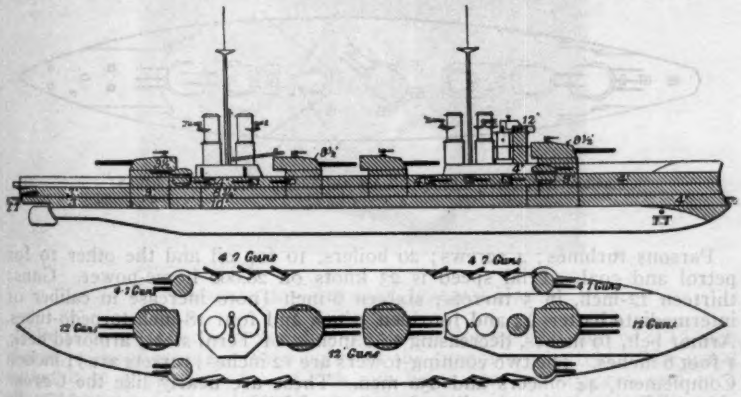
The big guns are 46 calibers in length, and are housed in barbettes with armor 9 inches thick, and with gun-hoods of armor 9½ inches thick. These guns fire an 850-pound projectile with a velocity of 2900 feet per second, and have a legend penetration of 17½ inches K. C. armor at 5000 yards. Her secondary battery consists of twenty 4.7-inch guns, of which eight are carried in four small twin turrets having armor 4 inches in thickness, the remainder being in batteries of three; the ports are recessed to obtain a larger firing arc ahead and astern. Twelve 12-pounders are also fitted. The

torpedo-tubes are three in number—one above the water-line in the stern, and one, submerged, on each broadside near the bow. These discharge the usual 18-inch Whitehead weapon.



"DANTE ALIGHIERI."

Protection to the water-line is afforded by a 10-inch belt amidships for about 230 feet of the length of the vessel, it thins to 7 inches as far as the end turret bases, thence it is continued forward of 4 inches thickness up to the top of the lower deck level, and of 3 inches thickness aft along the water-line only. Above this there is a 10-inch to 7-inch strake amidships—the



"DANTE ALIGHIERI."

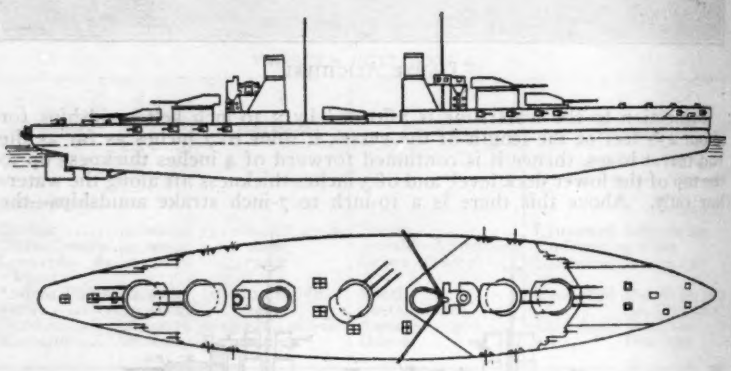
armor thins rapidly towards the top of the upper deck with 4 inches along each battery. The protective deck varies in thickness from 2½ inches to 1⅝ inches, and is reinforced at the bows by the belt armor being brought down below the ram. Forward the main conning-tower is of 12-inch and 11-inch armor.

Steam is generated in 23 Blechynden water-tube boilers, and, with turbines of 26,000 designed horse-power, the speed was estimated at 23 knots. On trial she registered 21,000 shaft horse-power and 21 knots at four-fifths power, and 35,000 shaft horse-power and 24.5 knots on the full-power eight hours' trial. A normal coal supply of 1000 tons is carried and 2500 tons can be accommodated.

The appearance of the ship is peculiar, the two pole masts being placed between the two pairs of funnels. The searchlights are carried on platforms built round the funnels, and the boats are manipulated by derricks swung on uprights connected to the main mast. Very little superstructure is shown, and the target is relatively small in consequence. Her cost was $10,912,500, and she is the sole representative of her class.—*Engineering.*

"DUILIO" AND "DORIA."—On March 29, at Spezia, the fifth dreadnought, *Andrea Doria*, was launched. Launching weight, 7500 tons.

Length between perpendiculars	554 feet.
Length, extreme	574 feet.
Beam	91 feet.
Draft	28.75 feet.
Displacement	22,400 tons.



ELEVATION AND DECK PLAN OF THE "ANDREA DORIA."

Parsons turbines; 4 screws; 20 boilers, 10 for oil and the other 10 for petrol and coal. Trial speed is 23 knots on 28,000 horse-power. Guns: thirteen 12-inch, in 5 turrets; sixteen 6-inch (note increase in caliber of intermediate battery); and fourteen 3-inch and four 18-inch torpedo-tubes. Armor belt, 10 inches, decreasing to 6 inches, of Terni steel; armored deck, 1 foot 6 inches. The two conning-towers are 12 inches; turrets are 11 inches. Complement, 44 officers and 950 men. These are nearly like the *Cavour* class, differing in intermediate battery and lattice work masts said to be similar to the *Wyoming*. The outline sketch is from *The Engineer*.

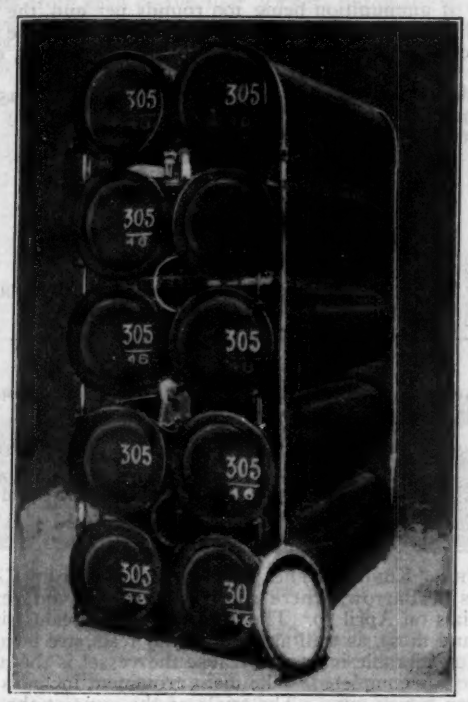
Her engines of 28,000 horse-power are Parsons turbines divided into three groups in three separate compartments, and are supplied with steam by 20 water-tube Blechynden type boilers, half of which are fitted for liquid fuel and half for "fixed combustion." Her normal fuel capacity is about 1000 tons and her estimated speed 22½ knots.

BUDGET, 1913-1914.—Amount is $49,550,147. The enlisted strength provided for is 35,000.

The Italian Cabinet, on the ground of cost, rejected the proposal to build four 35,000-ton battleships. It has been decided to build instead three ships of 28,000 tons, 25 knots speed, with nine 15-inch in three center line turrets.

Two 6000-ton cruisers, two cruisers for colonial service, many destroyers, two submarine salvage vessels, two fuel ships and one transport are to be built.

MAGAZINE ARRANGEMENT.—For the five dreadnoughts of the *Cavour* class a new scheme for storage of powder on board has been adopted which saves for each battleship 132 tons in weight and $180,000 in cost, when compared with the former system.



Moniteur de la Flotte.

AMMUNITION STOWAGE, ITALIAN NAVY.

The former copper tank weighed 95 pounds for each section of a 12-inch charge, without counting the weights of the supporting battens. The usual ammunition allowance of a 12-inch gun being 100 full charges, and each charge being in four sections, it was necessary to stow the 400 copper containing tanks, which made a weight of 36,960 pounds each gun without any account of the magazine crib work.

With this new scheme, however, to stow these 400 sections of charges, but 200 tubes of galvanized iron are required arranged in rows of 10 tubes each. Each tube holds two sections. The 200 tubes complete with their necessary structural work weigh but 7837 pounds each 12-inch gun. The extra weight of the old magazine crib work is eliminated; the chests of 10 tubes require only light supports.

Each tube is perfectly water- and air-tight. This fact was declared as the result of minute tests at Spezia, and hence a flooding of the magazines will not injure the charges.

The rapidity of handling the sections of the charges has answered every desire. Five seconds to open and remove cover from a tube and draw out the two sections of the charge.

The stowage is effected in such a way that if one section of a charge should burn up, the flame and gas therefrom will escape horizontally in the line of least resistance, and thus the effects will be completely localized.

Each tube, in the illustration given of a chest of 10 stowage tubes for 12-inch charges, is 4¼ feet in length, weighs 64.2 pounds and contains two sections of a charge. Each chest of 10 tubes then serves to stow five full charges and weighs, with the supports, bands, and stanchions, 391.6 pounds. The allowance of ammunition being 100 rounds per gun, the weight of all chests required is 7832 pounds. The old method of magazine stowage with its crib work, etc., weighed for same amount 36,960 pounds, or nearly five times as much.

By this simple improvement alone a saving of weight of 150 tons in the *Cavour* class has resulted, and the lesser cost is over many hundreds of thousands of francs.—*Moniteur de la Flotte.*

JAPAN.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Fuso.....	30,000	22.5	10 14-in., 16 6-in.	Kure	Laid down March 11, 1912
Battle-Cruisers					
Kongo.....	27,500	27	8 14-in., 16 6-in., 8 t. t.	Vickers	Under trials
Hiyei.....	27,500	27	same	Yokosuka	Launched Nov. 21, 1912
Haruna.....	27,500	27	same	Nagasaki	Keel laid Mar. 16, 1912
Kirishima.....	27,500	27	same	Kobe	" " Mar. 17, 1912

TRIALS OF THE "KONGO."—The Japanese battle-cruiser *Kongo* left the Vickers Works at Barrow, where she has been built, on her steam, gun, and torpedo trials on April 19. The programme of steam trials will begin early in May, and these, as well as the gunnery tests, are being looked forward to with considerable interest, because the vessel is the most powerful battle cruiser so far completed. The main armament includes eight 14-inch guns and sixteen 6-inch guns. The trials of the guns at the Vickers Eskmeals Range gave most satisfactory results. The *Kongo,* which was designed by the Vickers Company—a design adopted by the Japanese for three other vessels building in Japan—has a length of 704 feet, a beam of 92 feet, and at 27 feet 6 inches draft the displacement will be 27,500 tons. As the vessel is effectively armored and has a large number of small guns and submerged torpedo-tubes, she represents a happy combination of fighting qualities.

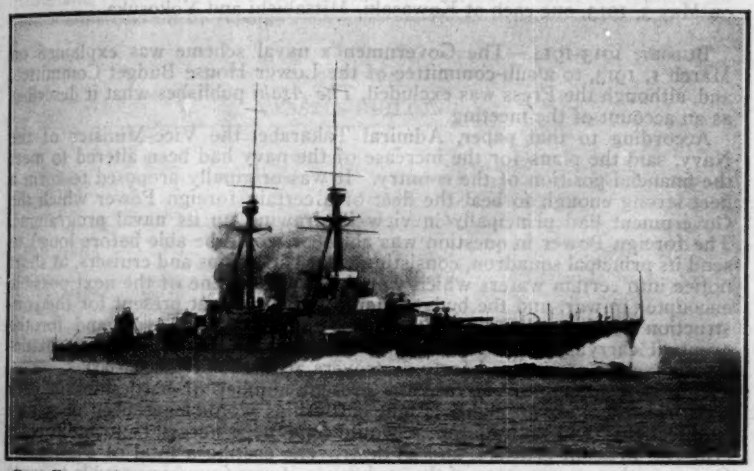
The officers and crew, numbering 577 in all, have arrived in this country and proceeded to Barrow on April 17 to take part in the trials and to man the vessel for her voyage to Japan, under the command of Capt. N. Nakano. —*Naval and Military Record.*

[A description of the *Kongo* will be found on pp. 1141 to 1143 of the PROCEEDINGS for September, 1912, No. 143.]

On May 8, in spite of the heavy gale, the speed attained was equal to that reached by the *Princess Royal*. The entire crew including stokers were Japanese. Under half power the vessel steamed 25 knots.

Results of Trials.—The structures on the quarterdeck in the illustration are water tanks fitted temporarily in order that water consumption by boilers might be measured absolutely. It is stated that on her eight-hour full-power trial, held on May 8 in stormy weather, the designed horse-power of 60,000 and the designed speed of 28 knots were both exceeded. Her mean shaft horse-power for 25 knots proved to be 40,000. The arrangement of turbines noted on page 142 of September, 1912, PROCEEDINGS, proved exceptionally satisfactory as regards steam consumption.

Gun Trials.—These were held on the 14th and 15th of May. Two hundred and fifty rounds from each of the four Vickers automatic guns were fired, followed by four rounds from each of the 3-inch guns, and by four or five rounds from each of the 6-inch guns. The guns in all cases were tried at various degrees of elevation and train. Then a salvo, using a contact in the



From Engineering.

BATTLE-CRUISER "KONGO" ON STEAM TRIALS.

conning-tower, was delivered from the eight 6-inch guns on the port side of the ship, the vessel meanwhile steaming at 12 knots. The 14-inch guns are the first of their caliber to be fired on board ship. The gun-mountings are of the Vickers hydraulic type, and have electric gear for use in the event of the hydraulic system in any way failing. In addition there is a small hydraulic installation for working the guns when they have to be cleaned, which gear serves for maneuvering the guns in the event of the main supply of power, either hydraulic or electric giving out. Another feature of the installation is the application for the first time of the Janney-Williams gear, which proved most reliable and exact in controlling the turret movement, creeping motion or great speed being achieved with equal facility and precision. Ten rounds per turret were fired at degrees of elevation ranging from maximum depression to maximum elevation, and at angles of from 90 degrees forward to 70 degrees abaft the beam. In some cases the hydraulic elevating and training gear was used, in others the electric. The "throw-off" was observed at each round by means of the training-indicator on the barbette. The length of the recoil and the pressure developed in the chambers were carefully recorded.

Several of the guns were fired in pairs, but the most crucial test was the firing of the whole of the 14-inch guns and of all of the 6-inch guns on the starboard beam, making sixteen guns in all. The firing was again from the conning-tower, and was absolutely instantaneous. It was remarkable that the cascades thrown up by the first contact with the sea of the 100-pound shot from the 6-inch guns were almost simultaneous, suggesting a remarkable uniformity in the trajectory of the guns. The second contact with the water in the case of these shots coincided with the first contact of the 14-inch shot, so that it was not then possible to distinguish between the 100-pound and 1400-pound shots. The salvo represented a discharge of something over 8 tons of metal, with a collective muzzle energy of about 600,000 foot-tons. The effect on the ship was scarcely perceptible, so far as inclination was concerned. No damage was done to the ship's structure, the only damage being to some of the lifeboats, the side-planking of which was sprung.—*Engineering.*

"FUSO."—The three sister ships were laid down in the Imperial dockyards on May 3, 1913, one each at Kawasaki, Mitsabishi and Yokosuka.

BUDGET, 1913-1914.—The Government's naval scheme was explained on March 1, 1913, to a sub-committee of the Lower House Budget Committee, and, although the Press was excluded, *The Asahi* publishes what it describes as an account of the meeting.

According to that paper, Admiral Takarabe, the Vice-Minister of the Navy, said the plans for the increase of the navy had been altered to meet the financial position of the country. It was originally proposed to form a fleet strong enough to beat the fleet of a certain foreign Power which the Government had principally in view in drawing up its naval programme. The foreign Power in question was able (or would be able before long) to send its principal squadron, consisting of 21 battleships and cruisers, at short notice into certain waters which would form the scene of the next possible encounter in war, and the budget therefore provides at present for the construction of three dreadnoughts of the most powerful type, and for the eventual carrying out of a scheme for eight dreadnoughts, four battle-cruisers, eight scouts, and forty destroyers at a cost of £36,500,000.

It was proposed to increase the present number of battleships in each squadron from six to eight. Eight battleships would have been necessary to effect this, and, in addition, it would have been necessary to build eight cruisers, 16 scout cruisers, and 48 destroyers, costing a total of £54,000,000. Owing to the present state of the exchequer, it was found impossible to carry out so vast a scheme of naval construction. Instead of eight battleships, seven would be constructed (seven dreadnoughts of 25,000 tons each), and instead of eight cruisers not more than four dreadnought cruisers would be built. The number of scout ships would have to be reduced to eight, and the number of destroyers to 46. This did not include the warships that were now in course of building. At Kure a battleship of 27,500 tons, to be named the *Fuso,* was being constructed, while no fewer than eight cruisers of 27,500 tons each were being built in different yards.

The Government did not think the cost of this programme would come to more than £39,260,000. The Government, however, would not embark on this scheme just yet, and would content itself for the present with what might be called the 93 million yen programme (£9,300,000). According to this the principal squadron of the Japanese Navy would consist of 12 ships—eight battleships and four cruisers. This squadron would be strong enough in itself to meet the squadron of 21 ships of the certain Power already alluded to. Three new battleships would have to be built to complete this modified programme.—*Press Association Foreign Special.*

JAPANESE DESTROYERS.—A notable fact is that Japan has now but two destroyers under construction. Since the war with Russia this nation

has practically ceased to build destroyers, the number launched from 1907 onwards being no more than seven. Russia, too, has not completed a single destroyer since 1908 with the exception of the *Novik*, but is now taking steps to make up for lost time, as nine vessels are now under construction and a further 36 on order. The policy of Japan in this direction is worth close attention. It cannot be due altogether to lack of funds, as she has five large super-dreadnoughts under construction. Possibly—the suggestion is made for what it is worth—the Japanese Navy is being built for a purpose in which small craft could play no part. The New Zealand Minister of Defence stated recently that that Dominion was not interested in sea-power because of Germany exclusively, and if, as many believe, the Japanese Navy is being built with one eye on our Pacific dominions, it may well be that Japan has come to the conclusion that destroyers would be a hindrance rather than otherwise, besides diverting capital from ships capable of undertaking a long voyage.—*Naval and Military Record.*

The two destroyers referred to are the *Sakura* and *Tachibana*, of 900 tons each and 33 knots speed. Three submersibles are under construction at Kuré, and two submarines are building at Vickers to serve as models for future construction in Japan.

RUSSIA.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Sevastopol	23,300	23	12 12-in., 16 4.7-in.	Baltic Works	Launched June 29, 1911
Petropavlovsk	23,300	23	same	" "	" Sept. 9, 1911
Poltava	23,300	23	same	New Admiralty	" July 10, 1911
Gangut	23,300	23	same	" "	" Oct. 7, 1911
Emperor Alexander III	22,860	21	12 12-in., 20 4.7-in.	Ivan Bunge Co.	" July 24, 1912
Empress Marie	22,860	21	same	" " "	Laid down Oct. 30, 1912
Catherine II	22,860	21	same	Nikolaieff	" " Oct. 1, 1912
Battle Cruisers					
Ismailia	28,000	27	9 14-in., 20 4.7-in.	Galerni	" " Dec. 20, 1912
Kinburn	28,000	27	same	Baltic Works	same
Borodino	28,000	27	same	Galerni	same
Navarino	28,000	27	same	Baltic Works	same

The *Gangut* class, consisting of the *Sevastopol, Petropavlovsk* and *Poltava* are dreadnoughts of 590 feet in length, 89 feet beam, 27 feet draft, displacing 23,000 tons, and with a shaft horse-power of 42,000, are designed to give a speed of 23 knots.

The battery consists of twelve 12-inch guns in four triple turrets on the center line, and of sixteen 4.7-inch guns. Four 18-inch submerged tubes are provided.

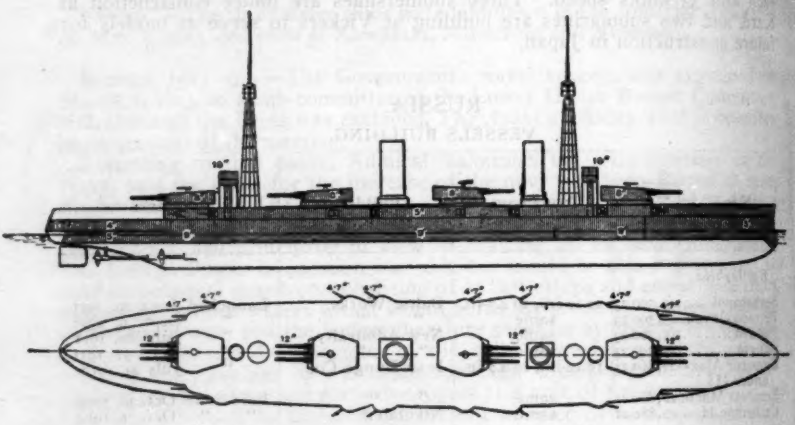
The boilers are Yarrow, the engines are Parsons turbines. Their oil capacity is 1170 tons, with a maximum coal capacity of 3000 tons. They have a complete armor belt 16 feet wide, only 8.8 inches thick amidships, tapering to 2.9 inches at the bow. The turrets are 8 inches thick, the conning-tower is 10 inches thick.

A discussion of this class occurs in the PROCEEDINGS for September, 1910, on pages 884 to 887, wherein the general design is criticized severely, the light belt, lack of torpedo-tubes, ice breaker bow, splinter bulkheads, underwater protection against torpedoes, boilers, arrangement of rudders, all

being condemned by *Engineering*. These vessels are not as far advanced as they should be, due presumably to constant changes and so on, ordered by the Marine Technical Committee.

BUDGET, 1913-1914.—The amount is $118,643,820. This carries out simply the small shipbuilding programme as noted heretofore, p. 389, last issue of the PROCEEDINGS.

ACCIDENT TO THE SUBMARINE "MINOGA."—This boat, under the command of Lieutenant Garsoev, was maneuvering off Libau, when she was seen to take a sudden plunge. The appearance of the emergency buoy first gave the alarm at three in the afternoon, but it was not until nine at night that the salvage vessels reached the spot. The weather conditions remained happily favorable, and divers having fixed the lifting chains the *Minoga* was successfully brought to the surface by midnight, having been nine hours at the bottom of the sea.



"GANGUT."

When the after hatch was opened three men staggered out, barely able to crawl. Fifteen of the crew and the captain were got out unconscious from the after part of the vessel. There remained only the coxswain, who was in the conning-tower amidships. It was necessary to raise the submarine well out of the water to get at the conning-tower, and this took another three hours work, but the coxswain, when released after twelve hours confinement, was in the best condition of any of the crew. Thus the whole command of twenty men was saved and the submarine recovered after lying nine hours at the bottom of the sea helpless.

The cause of the accident has been ascertained to have been a defective ventilator. Before exercising, these ventilators, which are indispensable to the proper action of the accumulators which provide the motive energy of submarines are screwed home from the inside. A ventilator in the forward part of the vessel was either defective or had not been properly screwed home, and water leaked in through this forward ventilator until the delicate trim of the submarine was affected and she plunged head foremost to the bottom. Water continued to enter until the air within the vessel was so far compressed as to resist the entrance of any more at a pressure of seven fathoms depth.

On this air the crew of twenty survived, the captain and fifteen men in the body of the vessel suffering also from the fumes of chlorine gas given

off by the accumulators. The three men who crawled out unaided by the after hatch and the coxswain, who after being confined in the conning-tower three hours longer than any of his mates was yet the least affected, were apparently out of reach of the chlorine gas fumes, and the coxswain, in addition, appears to have had more and better air to breathe. All have now recovered from the effects of their terrible experience.

SPAIN.

The *Alfonso XIII* was launched on May 7, 1913, at Ferrol. This class of vessels is described on page 390 of last issue. She has been on the stocks under a year. The third battleship, *Jaime I*, will also be launched within a year from her laying down. A second fleet to consist of three battleships of 21,000 tons, two cruisers, four gunboats, six destroyers, six torpedo-boats, and six submarines. The first battleship of this second fleet will be the *Reina Vittoria*.

UNITED STATES.

VESSELS BUILDING.

Number	Name	Displacement	Speed	Armament	Where Building	Launched	% of Completion May 1, '13
	Battleships						
34	New York....	27,000	21	10 14-in., 21 5-in., 4 t. t.	N. Y. Navy Yard	Oct. 30, '12	77.2
35	Texas.....	27,000	21	same	Newport News	May 18, '12	88.4
						Laid Down	
36	Nevada.....	27,500	20.5	same	Quincy	Oct. 26, '12	29.3
37	Oklahoma....	27,500	20.5	same	Camden	Nov. 4, '12	26
38	Pennsylvania	31,400	21	12 14-in., 22 5-in., 4 t. t.	Newport News	....	....
39	Authorized	....	....	....	....	....	....

"PENNSYLVANIA" (further details).—The distinguishing features of the design above the deck are the two military masts, one smoke-stack and fore-and-aft turrets, each equipped with three 14-inch guns. In the sub-divisions below decks cofferdams surround all the fuel-oil tanks as a means of protection and safety.

Propelling Machinery.—The propelling machinery will consist of an improved type of Curtis turbines placed in four water-tight compartments, the turbines operating four shafts and propellers. The characterizing feature of the turbine installation proposed will be found in the arrangement of gearing in connection with cruising turbines to be used under cruising conditions. For purposes of disconnecting the cruising outfit, when running at higher speeds, a clutch is provided in the shafting between the main low-pressure turbine and the gear shaft.

In the arrangement of the turbines there are placed on the inboard shaft the main high-pressure turbine in the forward engine room and an independent backing turbine in the engine room located immediately aft of the forward one.

On the outboard shaft, in the forward engine room, is placed the reduction gear casing with the two cruising turbines, each of which connects with a pinion engaging with a large central gear. At 1800 revolutions per minute of the cruising turbines the gear revolves 120 revolutions per minute. The main low-pressure turbine, with its ahead and astern elements, is placed

in the after engine room, an extension of the rotor shaft connecting with the reduction gear.

When running at cruising speed, steam is admitted as follows: First to the high-pressure cruising turbine, then to the low-pressure cruising turbine with driving gear attached to the low-pressure turbine, then to the high-pressure main turbine driving the inboard shaft, and finally to the low-pressure main turbine driving the outboard shaft. All propellers turn outboard for ahead motion.

The usual auxiliaries consisting of condensers, main and auxiliary air pumps, feed tanks, main circulating pumps, feed heaters, etc., are located in the engine rooms. The vacuum to be maintained under full speed conditions is to be one pound below perfect vacuum of the prevailing barometric pressure.

Forced lubrication, together with water circulation in the rotor journals and the horse-shoes of the thrust bearings, is provided.

Boilers.—There will be installed 12 water-tube boilers, in which the diameter of the tubes is not to exceed 2 inches. The boilers will be designed for burning fuel-oil by mechanical atomization in the burners. The burners will be of the Bureau of Steam Engineering type. The fuel-oil system will consist of the necessary pipe systems, light and heavy service pumps, tanks, strainers and oil heaters. For control of operation there will be oil meters in the suction pipes, gears for operating fuel-oil valves and level indicators placed near the storage tank manifold. Hand pumps capable of delivering air to a few of the burners at 200-pound pressure, when the boilers are cold, form part of the equipment.

Air for combustion is furnished by forced draft blowers, the mixing of the air and the atomized oil taking place within the furnace of each boiler.

The steam pressure at boilers will be about 295 pounds gauge, while at the turbines it will not exceed 265 pounds. The total shaft horse-power will be about 32,000 at 220 revolutions per minute.

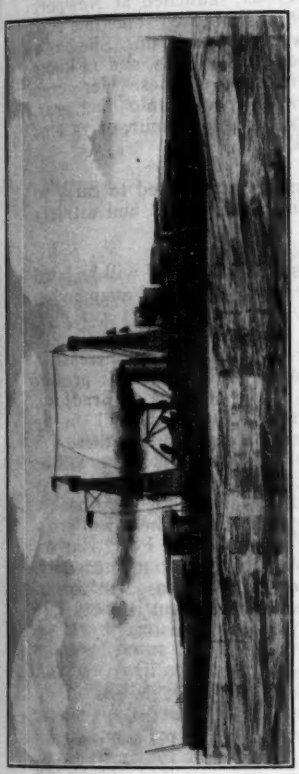
The four-shaft turbine arrangement in the ship in question is a singular departure from prevailing customs with the Curtis turbine for marine use, where either two or three-shaft arrangements have been the rule. The former was used in the *North Dakota* and in all of the torpedo-boat destroyers, the latter in such ships as the Argentine battleships *Rivadavia* and *Moreno* now building in this country.

A comparison between turbine and reciprocating engine installations for a ship like the one forming the subject of this article will show the diameter of the screws for the former to be 13 feet against 21 feet for the latter, the diameter of shafting 12.5 inches against 20.5 inches, the stress on the shafting 6500 against 9500 pounds per square inch of section, etc.

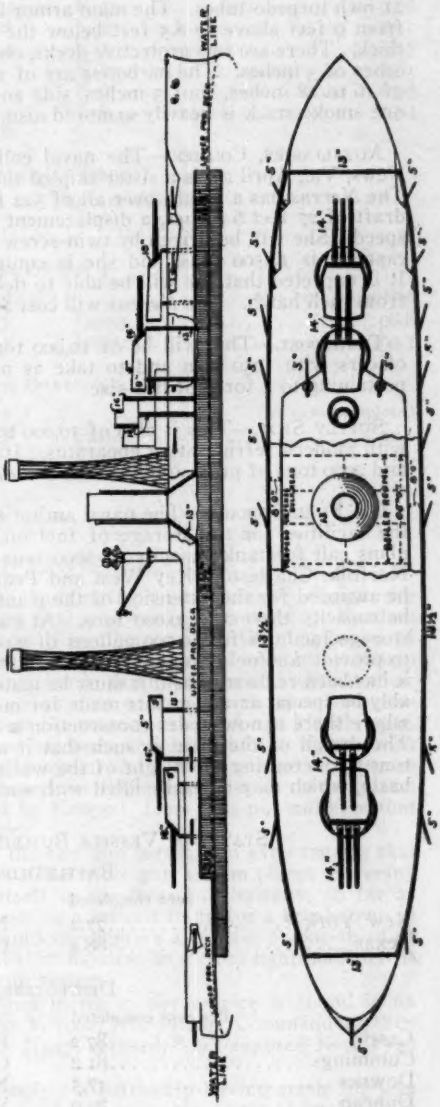
Considering the expected improvements in economic performance, both at full power and under cruising conditions (as due to better turbine arrangement, more efficient screws when the turbine power is divided among four screws as compared with two or three screws in former ships, and the geared cruising turbines), the growing tendency towards larger and speedier ships and the tactical advantages existing in the uniformity of ships, when in squadron, it seems quite in keeping with the progressive policies adopted by the navy to have accepted the contractor's proposition to install turbines in place of reciprocating engines for the propelling machinery of this latest, most modern and powerful dreadnought.—*International Marine Engineering.*

"OKLAHOMA" AND "NEVADA."—These vessels are the first to have triple gun turrets in our service. The *Oklahoma* was laid down at Camden, New Jersey, on October 26, 1912, and is due for completion on January 22, 1915. The *Nevada* was laid down at Quincy on November 4, 1912, and is to be completed on same date as the *Oklahoma.*

These vessels are 575 feet long, 95 feet beam, 28.5 feet draft, displacing 27,500 tons. Speed is to be 20.5 knots. They burn oil only, carrying about



U. S. S. "OKLAHOMA" AND "NEVADA."



ELEVATION AND PLAN, U. S. S. "OKLAHOMA" AND "NEVADA."

2000 tons. The *Nevada* has Curtis turbines, 12 Yarrow boilers, 26,500 indicated horse-power. The *Oklahoma* has two triple expansion engines and uses 12 B. & W. boilers. There are to be ten 14-inch 45-caliber B. L. R. in two triple and two double turrets, twenty-one 5-inch 51-caliber, and four 21-inch torpedo-tubes. The main armor belt is 17½ feet in width, extending from 9 feet above to 8.5 feet below the water-line and will be 13.5 inches thick. There are two protective decks, one of 1.5 to 2 inches in thickness, the other of 3 inches. The barbettes are of 13-inch armor, the turret port plate of 16 to 18 inches, roof 5 inches, side and rear armor 10 to 9 inches. The one smoke-stack is heavily armored also.

AUXILIARIES, COLLIER.—The naval collier *Nereus*, launched at Newport News, Va., April 26, is a sister ship of the *Proteus*, launched sometime ago. The *Nereus* has a length over all of 522 feet, with 62 feet beam. She has a draft of 27 feet 6 inches, a displacement of about 19,000 tons, and 14 knots speed. She will be driven by twin-screw reciprocating engines. Her cargo capacity is 12,500 tons, and she is equipped with special unloading gear. It is expected that she will be able to deliver 900 tons per hour, or 75 tons from each hatch. The *Nereus* will cost $990,000.

TRANSPORT.—This will be of 10,000 tons displacement, fitted to carry 70 officers with 1250 men and to take as provisions, equipment and artillery pertaining to a force of this size.

SUPPLY SHIP.—This is also of 10,000 tons displacement, and will be fitted with modern refrigerating apparatus. It will carry 250 tons of ammunition and 2000 tons of provisions.—*Moniteur de la Flotte.*

OIL FUEL STORAGE.—The naval authorities are considering the increase in the facilities for the storage of fuel oil, gasoline, and coal. The present plans call for tank capacity of 5000 tons each at the stations at Bradford, Norfolk, Charleston, Key West and Pearl Harbor. Contracts will shortly be awarded for the extension of the plant at Guantanamo so that there will be capacity there for 30,000 tons. At each of those stations there will be storage facilities for 90,000 gallons of gasoline. The original intention was to provide for fuel-oil capacity to the extent of 2500 tons at each station, but it has been realized that this must be materially increased. There will probably be special arrangements made for meeting conditions at Pearl Harbor, where there is now under construction a coal plant of 100,000 tons capacity. The design of the plant is such that it may be easily increased to 200,000 tons by increasing the height of the walls. The storage plant is a concrete basin, which may be easily filled with water.—*Shipping*, Illustrated.

STATUS OF VESSELS BUILDING ON MAY 1, 1913.

BATTLESHIPS, 4.

	Per cent completed		Per cent completed
New York	77.2	Nevada	29.3
Texas	88.4	Oklahoma	26.0

DESTROYERS, 14.

	Per cent completed		Per cent completed
Cassin	87.2	Balch	88.5
Cummings	81.2	O'Brien	1.3
Downes	47.5	Nicholson	1.2
Duncan	79.0	Winslow	1.2
Aylwin	92.1	McDougal	4.4
Parker	89.2	Cushing	8.9
Benham	87.9	Ericsson	5.0

SUBMARINES, 15.

	Per cent completed		Per cent completed
F-4	100	K-2	76.8
G-4	88.4	K-3	75.6
G-2	87.2	K-4	75
H-1	90.4	K-5	58.7
H-2	90	K-6	57.1
H-3	88	K-7	65.3
G-3	67.4	K-8	63.4
K-1	76.6		

SUBMARINE TENDERS, 1.

	Per cent completed
Fulton	11.6

FUEL SHIPS, 4.

	Per cent completed		Per cent completed
Proteus	90.7	Jason	98.8
Nereus	87.1	Jupiter	99.1

GUN BOATS, 3.

	Per cent completed		Per cent completed
Sacramento	11.1	Palos	32.7
Monocacy	32.7		

ORDNANCE AND GUNNERY.

GUNS AND PROJECTILES.

MULTIPLE GUN TURRETS.—These, judging by recent warship design, are advancing in favor and are to have a trial in several navies at least. Readers of the PROCEEDINGS recollect that in November, 1912, a German board of naval officers after witnessing tests of a triple gun mount erected by Krupp reported against further experimentation in that direction and against their adoption into the German Navy. Slow rate of fire, interference and confusion among the loading crews were the reasons assigned. In March, 1913, however, we read that a new board has been appointed by the Kaiser with instructions to investigate the subject again, and particularly with reference to the reported success of the American triple turret built on a system different from the one under trial by Krupp. Thus it is not unlikely that Germany will adopt the triple turret.

The British Navy still clings to the two gun turret, and even regrets that single gun turrets are not the rule. The triple gun system places too many eggs in one basket to commend itself to the British Admiralty, so far as experience goes at present. It would be a serious thing for a breakdown in the turret-working machinery to suddenly deprive a captain of one-third of his heavy fighting ordnance at a critical moment in a close fight, and that is one of the dangers of any triple gun system.

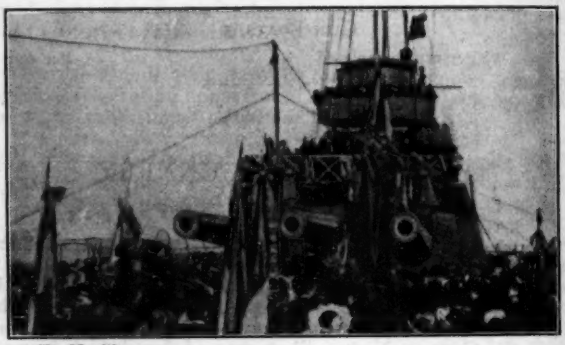
The first proposal for a three gun turret in any service is found in an article in the PROCEEDINGS for March, 1902, No. 101, by Commander—then Lieutenant—Matt. H. Signor, U. S. Navy, entitled, "A Proposed New Type of Battleship."

Italy was the first nation to complete a battleship having triple big-gun turrets. They have nothing but praise for them as the result of trials. It is said that the middle gun is fired first, then, if a hit follows, the other two are fired together. The *Dante Alighieri* was the first completed triple gun turret man-o'-war.

Austria in her *Viribus Unitis* has a very successful ship with heavy end on fire, heavier than is that of the Italian. It is, however, reported that considerable damage was caused to the *Viribus Unitis* by the simultaneous firing along the axial line of the six 12-inch guns in two forward turrets, and as a result it is proposed to modify the design of the *Prinz Eugen* and the *Schwartzenburg*. Details of the mounts are very meager.

The Austrian guns have been said to be each mounted in a separate sleeve and fitted for elevating together or separately as desired. Gunnery officers will appreciate difficulties that must be met in such a system due to slight inaccuracies in the lining up of the guns. Photographs show them to be quite widely separated, and therefore it is surmised that when desired, as in disablement of one gun, they can be handled separately. The method of mounting the Italian guns is not known. The Russian triple turrets have not as yet been fired, and Russia is making slow progress toward the completion of the *Gangut* class. Our triple gun mounts have been tested at the proving grounds, though it will be some years yet before the completion of the *Oklahoma*, the first in our service to be fitted with triple turrets.

The French have now committed themselves to the four gun turret, after much study of the subject, and her *Normandie* class is to be so fitted.



a Vie Maritime

TRIPLE TURRET OF THE "VIRIBUS UNITIS."

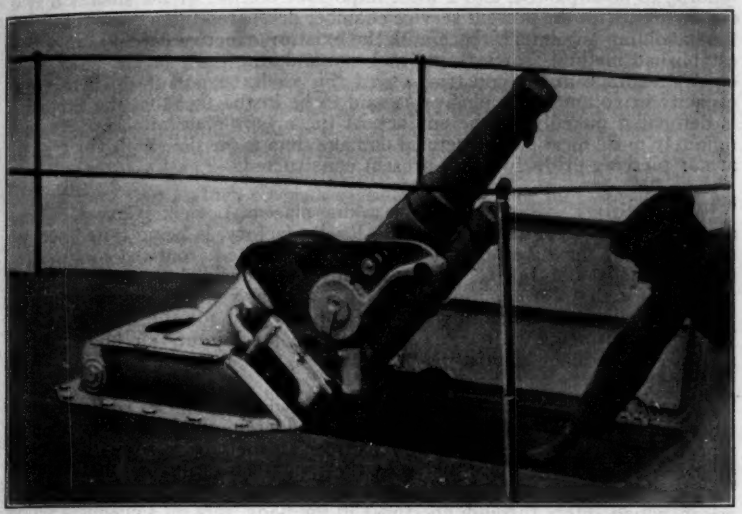
Judging from the only sketches thus far seen the guns are to be mounted in pairs, two in each sleeve.

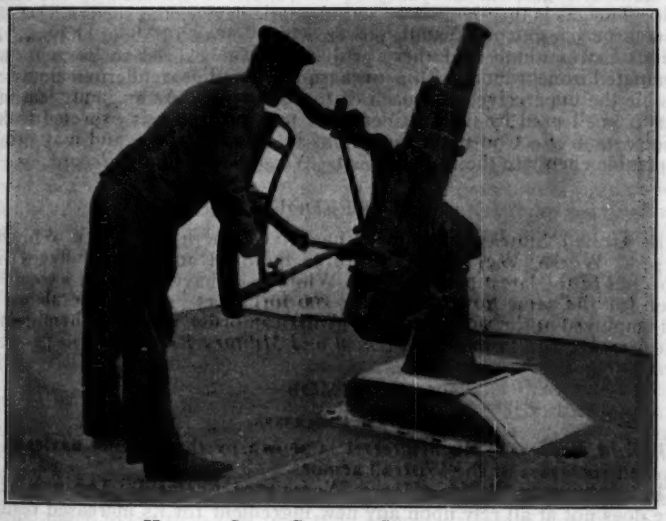
In order that the types of the various vessels built or building with triple and quadruple turrets may be compared, the data relative to them have been placed with their respective navies, even though slight repetition has been caused thereby.

GUNS FOR SUBMARINES.—Illustrations of guns built by the Krupps are given below. They are built in several calibers, the cut showing the 3-inch weapon. They are mounted so as to be capable of elevation sufficient to attack air craft. The sight has a panorama angle telescope with universally rotating objective prism head, the eye piece not being moved in taking aim.

A disadvantage of such a gun on a submarine is that it and its ammunition requires a large amount of space in the already overcrowded compartments of the vessel. When temporarily disabled a gun to a submarine might, however, be of value in beating off torpedo vessels or boarding parties. The newest type of German submarine of 800 tons is to be fitted with two 3-inch guns. Their total weight is given as 1496 pounds. Twenty seconds is the time taken to bring a gun up from the hull and to fire the first shot. This submarine is to be armored on its deck, conning-tower and exposed hull.

The Diesel motor of 900 horse-power is to give the vessel 12 knots submerged and 17 knots surface speed. The first vessel of this class is *U-21*, built at Danzig.





KRUPP 3-INCH GUN FOR SUBMARINES.

ENGLISH HIGH CAPACITY SHELL.—It is reported that experiments are in progress with a new design of shell for the navy's new 13.5-inch gun which, if adopted, will increase the effective fire of the gun. A provisional patent has been granted the inventor for the design, which has already been

brought to the notice of the naval authorities. It is claimed for the new design that when considered in connection with the broadside fire of ten 13.5-inch guns it will enable about 2000 pounds of high explosives, such as lyddite, to be exploded, and a most important feature of the shell is that it can be fired with the present service chamber pressures and muzzle velocities, thus avoiding any interference with the existing effective fighting range and established methods for sighting and manipulating the gun-fire. The principal advantage in the construction of this shell, beyond its high carrying capacity in volume of explosive, is said to be in the fact that the explosive is detonated nakedly on the surface of the armor plate attacked, creating infinitely more local and structural damage than is possible with any type of armor-piercing projectile as at present constructed.—*The Engineer.*

FRENCH SHELL.—Experiments are taking place at Lorient (Gâvres), where a 13.4-inch gun, just delivered by the Ruelle factory, is being tested against the turrets of the *Liberté*. Useful data are expected from the comparative tests of shells and fuses. It has already been decided that the 13.5-inch weapons for the *Normandies* shall have a greater velocity and perhaps also heavier shells, than those in course of construction for the *Bretagnes*. At Toulon experiments with a new type of "obus éclairant," or high capacity shell are being made against the torpedo-gunboat *Faucon*.

ILLUMINATING SHELL.—A novel projectile which promises to be of great value in repelling torpedo attack at night is understood to have been adopted recently in the German Navy. This special shell is filled with calcium carbide. It is fired in the usual way, the range being equal to that of ordinary shells. On striking the water it sinks for a short distance, when the water, which enters through apertures in the body, sets up a chemical action and generates gas, the buoyancy of which drives the shell to the surface again. The gas is then ignited by an automatic device, and sheds a light equal in the large sizes, to 3000-candle power, which burns for about an hour. It is obvious that a number of these projectiles can be fired so as to form an illuminated zone round a ship or a squadron, thus rendering almost impossible the unperceived approach of torpedo craft. As an improvement on the star shell used by field artillery this new projectile is expected to have an important effect on night operations in naval warfare, and may prove a formidable enemy to the torpedo-boat.—*Naval and Military Record.*

TORPEDOES.

The United States Government has given an order to the Whitehead Torpedo Works, Weymouth, for three hundred and seventy-five 21-inch torpedoes of the latest pattern. The Whiteheads have only just executed an order for the same government for 200 torpedoes. There are about 1200 men employed at the works, and the American order will keep them going at high pressure for 12 months.—*Naval and Military Record.*

ARMOR.

NEW PROCESSES.

Sheffield Process.—Much interest is shown by the various navies in the reported successes of the Worrall armor.

The inventor is William Henry Worrall, of Sheffield. The new armor plate does not at all rely upon any new ingredient for its increased resisting power, but this is obtained as the result of a different process of hardening, largely secured by the welding or bonding of four or six sheets of metal into one plate, instead of molding the plate as a whole in one ingot. The main object is to effect a thorough homogeneous hardness. This will permit of ironclads being as efficiently protected with much thinner and lighter plates than is at present the case.

Several experts express some doubt as to whether the welding of a number of plates contributes to greater homogeneity. They all agree that experiments conducted on somewhat similar lines have not hitherto been attended with success. Dr. J. O. Arnold, F. R. S., Professor of Metallurgy at Sheffield University, said:

"Practical experience in armor plate manufacture is that you must have the face sufficiently hard and with a sufficient depth of hardness to smash up a shell. No reliable estimate can be formed of the value of a plate until it has been drastically tested by the admiralty under standard conditions. So far as I know there is only one plate of this so-called bonded process of manufacture which has been so tested, and that was a failure. There is a new system of manufacturing armor plates, at present in the experimental stage, which consists of welding a face of high-speed steel on to the relative soft backing of the plate. This has been done with some measure of success, but the ultimate value of the plate can only be determined by an admiralty test. I see it is claimed that Mr. Worrall's plate has withstood a 14-inch shell. If that is so it must have been an admiralty test, because I do not think any private firms are equipped with such a gun. The cost of this alone would be about $150,000, and the shell would cost $600. In the absence of further information as to the process and the nature and conditions of the test, I prefer to offer no more definite opinion as to the value of the invention."—*London Times.*

Schaumann Armor.—In recent years so many rumors about new armor processes have come to the fore, each promising a revolution in existing methods of manufacture, and failure has attended the subsequent experiments with such regularity, that the technical world has very naturally grown somewhat skeptical. According to information now being published in Germany, however, a notable advance in the preparation of armor plate is represented by a new process invented by an engineer named Schaumann. Schaumann armor consists of several plates cemented together, and its most valuable quality is the combination of remarkable lightness with great resisting power. In both respects it is stated to be immeasurably superior to the nickel-steel armor now in general use.

A test recently was carried out on a military rifle range. Two plates were fixed to the butts, one of nickel-steel ⅛ inch thick, the other of Schaumann armor, whose thickness corresponded to that of a nickel-steel plate ⅜ inch thick. At a range of 540 yards both plates were fired at with an army rifle, the cartridges having a heavier charge than usual. Every bullet that struck the nickel-steel plate made a clean perforation, while the Schaumann plate was not pierced once, and after being frequently hit showed scarcely any trace of injury. The range was then reduced to 87 yards. A nickel-steel plate 9-32 inch thick was penetrated at every shot, but a Schaumann plate equal in weight to a ¼ inch plate of the first-named armor sustained no serious damage. The result of this test appears thoroughly to have roused the interest of the authorities, and it is understood that more elaborate experiments have since been made, with uniform success to the Schaumann armor. It is reported that plates of considerable thickness, prepared after the same method, have exhibited relatively the same high powers of resistance.

Roughly speaking, Schaumann armor is 30 per cent lighter than nickel-steel armor manufactured by the Krupp method. Moreover, it can be made at a cost much lower than that of Krupp armor. It would appear to be the ideal armor for small warships, where weight is a consideration, and the inventor suggests its application, in particular, to torpedo craft, submarines, aeroplanes, and dirigible airships. A report states that the gun shields of a cruiser of the *Breslau* class are made of the new armor.—*Naval and Military Record.*

TARGET PRACTICE.

FRENCH TARGET PRACTICE.—On March 3 the French battleship squadron had target practice with M. Baudin and Mr. Churchill as witnesses aboard the *Voltaire*. This is the first firing since July, 1912, and the results are given below, the mean ranges being 8500 to 9500 meters.

	1st run	2d run
Voltaire	53%	26%
Condorcet	16%	43%
Danton	50%	33%
Mirabeau	33%	12%
Vergniaud	29%	25%
Diderot	15%	36%

In spite of the new restrictions and the use of the hydro-pneumatic sponging recently fitted to the guns, no marked slowing up of the fire seemed to result.—*La Vie Maritime.*

The exercises were conducted in the usual way, partly against canvas targets, and (after the destruction of the latter) partly against a small rock (La Vacca) off the Corsican coast, which is 60 meters long and rises some 4 meters above water. The range was of about 8500 meters in the first case and of under 7000 in the second. The *Première Escadre* obtained up to 53 per cent of hits, the best ships being as usual the flagship *Voltaire* and the *Danton*. The 9.4-inch guns did not prove inferior in accuracy to the 12-inch type, which confirms the demonstration made last year by Admiral Gauchet in the *Mirabeau*. At the same time, the rate of fire was rather lower than that maintained in the battle practice of June last. In this respect there is reason to fear the French Navy is not yet quite up to the standard of other great fleets. The performance of the *Deuxième Escadre* was also satisfactory. The best ship again proved to be the *Justice* with a percentage of under 40 hits, a result which compares poorly with the 60 per cent hits she obtained in 1911. This time, out of twenty 12-inch rounds and 74 rounds of 7.6-inch fired within 8 minutes, she made 7 hits with the larger weapon and 34 with the smaller one.

On the whole, the ships of the *Patrie* class did much better with their secondary armament (7.6 and 6.4-inch) than with their big guns—a fact noted by the partisans of volume of fire theories. For instance, the *Patrie* made 72 hits out of 198 rounds of 164 mm., and only two hits out of twenty 12-inch rounds. Similarly, the *Vérité* obtained 50 per cent hits with her 194-mm. weapons, but missed altogether with her 12-inch battery. A further demonstration of the accuracy at long range of medium-sized calibers was afforded by the performance of the *Ferry* (four 7.6-inch and sixteen 6.4-inch guns), that secured 57 per cent hits. The misfortune is that, with modern battle ranges and against modern ships, 110-pound and even 200-pound shells have become practically a negligible factor.—*Naval and Military Record.*

Four battleships made four runs each, and the following was the result in actual hits per minute in the target for the batteries:

Patrie	3.24
Suffren	2.36
Justice	2.69
Vérité	1.62

ENGLISH BATTLE PRACTICE, 1912.—The returns are officially published: The conditions of the practice, it is stated, differed widely from those of previous years, so that no comparison can be made. The champion ship, according to the tables, is the *Colossus*, of the second battle squadron, which, firing in "very good" conditions with her ten 12-inch guns made 368 points. The *Orion*, of the same squadron, takes second place with 350 points, the conditions under which she fired having been "good." Next in order were

three ships of the first battle squadron, all armed with 10-inch guns, the *Bellerophon* making 346 points, the *Dreadnought* 342, and the *Superb* 339. The *Hercules* was sixth with 325, and then came two battle-cruisers, the *Invincible* with 324, and the *Indomitable* with 322. The first fifteen all had the advantage of good or very good conditions, the first to suffer by the weather being the *Irresistible,* which made 242 points in bad light, while rough sea and other causes hindered ships lower down the list.

The most gratifying feature of this battle practice is the greatly improved position occupied by the dreadnoughts and super-dreadnoughts in commission. The *St. Vincent* is not included in the general classification owing to lack of success attributable to unusually difficult conditions, but the other fifteen ships of the all-big-gun type take that number of positions in the first 22 places on the lists for battleships and battle-cruisers. The ships carrying 13.5-inch guns fill the second, fifteenth and twenty-second places respectively, the 12-inch ship *Colossus* occupying the first place with 368 points to her credit.

The ship at the top of the battleship list did more than three times as well as the ship at the bottom of the list—the pre-dreadnought *Formidable.* Both ships fired in very good weather.

Of the cruisers, the best was the *Monmouth,* which was on the China Station, and which (with her fourteen 6-inch weapons) made 365. The *Warrior* (second cruiser squadron) is a close second with 363, and then, after a long interval, comes the *Cochrane* 296. The *Yarmouth* (fourth battle squadron) was easily the best of the light cruisers with 745 points, while, of the three vessels at the Cape, that fired at fixed targets, the *Hermes* is placed first. Among the vessels not included in the general classifications owing to lack of success attributable to unusually difficult conditions or the failure of some portion of their organization are the *St. Vincent* and the *Hindustan.*

In the destroyer and torpedo-boat class many excellent scores were made, the destroyer *Nerside* coming first with 169 points, made in very good weather; she is followed by the *Acorn,* of the *Acheron* and *Acorn* classes with 72 points, made in unfavorable conditions.

ENGLISH GUNLAYERS' TESTS.—The Admiralty has published the returns of the tests of gunlayers with heavy guns during last year, the figures relating to 1510 guns in 115 ships, fired by 1232 men, who used 6955 rounds. The average of marksmanship of the squadron is represented by a score of 80.763, the best return being that of the Mediterranean squadron of 108.130, followed by the Australian squadron with 102.986. The first battle and cruiser squadron returned the third best average score of 99.602.

Of individual ships, the best record is that of the *Superb* with a score of 162.75, the *Yarmouth* (Mediterranean fleet) being second best with 158.33, and the *Challenger* (Australian squadron) next with 148.48. The *Superb* made 31 direct hits with 12-inch guns out of 36 rounds fired, as compared with her 17 direct hits in the previous year. The best shot in the ship was Petty Officer T. H. Martin, with four hits out of the four rounds fired. There are, however, several individual gunners in other ships who hit the target with every shot.

Other squadrons in order of merit, with their best ships, are: East Indies, *Highflyer;* China Station, *Minotaur;* second battle and cruiser squadrons, *Colossus;* fourth battle squadron, *Cornwallis;* third battle and cruiser squadrons, *Weymouth;* Cape of Good Hope, *Hermes;* fifth battle and cruiser squadrons, *Prince of Wales;* flotilla cruisers, *Active;* training squadron and attached cruisers, *Leviathan;* and special service tenders, *Bonaventure.* There is no comparison given with previous year's results, nor official comment.

Of 13 squadrons, two only returned a score of less than one hundred for their best ship. As to guns, the percentage of hits obtained with the new

13.5 weapons was 58. With the 12-inch B. L. as mounted in the *King Edward VII* and later ships, the percentage of hits was raised from 37.3 of last year to 55.02, whilst the percentage for the 12-inch B. L. of earlier date remained almost constant at 35.5.

As regards the arrangement of the ships, the bracketing of the *Colossus*, *Dreadnought*, and *Neptune* in the seventh place with the 12-inch gun presents some points of interest. All three made 23 hits; but the *Colossus* only threw away 10 shots in making them, while the *Dreadnought* wasted 14 and the *Neptune* 16. In other words, the effective percentage of the *Colossus* was 69.7, of the *Dreadnought* 62.2, and of the *Neptune* only 59. Apparently the last two vessels take their equality with the *Colossus* on the ground of their greater rapidity of fire, *but of what use is rapidity of fire if it only means rapidity of missing?*

Of individual gunners, two dozen returned six hits for six rounds; nine, five hits for five rounds; seventeen, four hits for four rounds; and five, three hits for three rounds.

The best ships and shots in the heavy G. L. test are as follows:

First battle and cruiser squadrons—Superb: Shots 36, hits 31; best shot in ship, T. H. Martin, P. O.

Second battle and cruiser squadrons—Colossus: Shots 33, hits 23; best shot, E. F. Massey, leading seaman.

Fourth battle squadron—Cornwallis: Shots, 85, hits 54; best shots, W. A. Adlam, leading seaman, and J. Medway, P. O.

Third battle squadron—Weymouth: Shots 42, hits 27; best shot, F. Kier, A. B.

Fifth battle and cruiser squadrons—Prince of Wales: Shots 74, hits 43; best shots, W. Hatton, C. P. O., and H. Hart, A. B.

LIGHT GUNLAYERS' TEST.—The return of the tests with light quick-firing guns relate to 6929 rounds, fired by 99 ships, with 1283 guns. The average score is 86.871 per squadron, the best squadron return being 113.33, by the first battle and cruiser squadron; the second, 110.29, by the Australian squadron; and the third best 109.36, by the China squadron. The best individual ship score was the 133.33 of the *Bonaventure*, the *Minotaur* and the *Cornwallis* being second and third respectively.

The leading fleet is the first battle and cruiser squadrons, with the *Dreadnought* as best ship; Australian fleet, *Drake*, second; China, *Minotaur*, third; fourth battle squadron, *Cornwallis*, fourth.

The returns, analyzed to show the results according to types of guns, indicate an all-round and very marked improvement on those of 1911, the percentages of hits ranging from 60.5 with the 12-pounders, to 78.2 with the Vickers 3-pounders. With these light guns 79 men made six hits in six rounds.

The best ships and shots are as follows:

First battle and cruiser squadrons—Dreadnought: Shots 139, hits 96; best shot, J. Cotman, leading seaman.

Fourth battle squadron—Cornwallis: Shots, 58, hits 53; best shot, F. Gorman, private, R. M. L. I.

Second battle and cruiser squadrons—Warrior: Shots 138, hits 131; best shot, J. Hunt, sergeant R. M. A.

Amethyst: Shots 44, hits 33; best shot, C. Scott, A. B.

Fifth battle and cruiser squadrons—London: Shots 89, hits, 64; best shot, F. Ellis, P. O.

Third battle and cruiser squadrons—Dominion: Shots 130, hits, 103; best shots, F. Arnold, A. B., and C. E. Frost, L. S.

TORPEDO CRAFT RETURNS.—The returns relating to the firing of 871 guns on board 168 torpedo-boat destroyers and 30 torpedo-boats show 2486 hits and 2717 misses, or a percentage of 47.78 of hits. In this case the *Nautilus*

and *Bulldog* are bracketed equal at the head of the list, the one with five and the other with six hits for six rounds.

BATTLE PRACTICE RESULTS.—The results of battle practice in the fleet during 1912 were circulated in a *White Paper* issued on Monday. The conditions of the practice, it is stated, differed widely from those of previous years, so that no comparison can be made.

The best battleship or battle cruiser, according to the tables, is the *Colossus*, belonging to the Devonport command, which, firing in very good weather conditions with her ten 12-inch guns, made 368 points. The *Orion*, attached to Devonport, takes second place with 350 points, the conditions under which she fired having been "good."

The first 15 all had the advantage of good or very good conditions, the first vessel to be penalized by the weather being the *Irresistible*, which made 242 in bad light; while rough sea and other causes hindered ships lower down the list.

Of the cruisers, the best is the *Monmouth* (attached to Devonport for manning purposes), which was on the China Station, and with her fourteen 6-inch guns made 365 points. The *Warrior* (second cruiser squadron), also a Devonport division ship, is a close second with 363 points.

The *Yarmouth* (fourth battle squadron) was easily the best of the light cruisers, with 745 points.—*Naval and Military Record.*

GERMAN TARGET WORK.—For a long time the German battleships have fired only at a range equal to the maximum for 3-inch guns. Some months ago the general staff apparently abandoned the theory of maintaining a heavy volume of fire with the intermediate battery, and accepted the principle of opening fire at the extreme limit of effective range for the main battery. Strenuous drills of this kind are being held to regain the ground and time lost. But the results show, according to what should be considered reliable information, that the German Navy does not possess an efficient fire control or spotting system.

Firing against aeroplanes is actively carried on, vessels being fitted with shortened capable of being pointed vertically. The target, however, has been seldom hit. The tracers used are not successful.—*Le Yacht.*

FIRE CONTROL.

SCOTT FIRE-DIRECTOR.—Estimates have been approved for fitting the battleship *Centurion*, at Devonport, with a "fire-director" outfit in which all the improvements resulting from the *Thunderer's* trials will be embodied.

The *Centurion* has a single steel mast, and during the recent trials observations were made to ascertain the amount of vibration of the mast at varying speeds. These observations were not favorable to the single mast as at present supported in the *Centurion*, the loss of rigidity being such that it would seriously detract from the fire efficiency of the director; consequently, as a preliminary to mounting the instrument, it will be necessary to increase the stability of the mast. This can be done either by the provision of additional wire rigging or by reverting to a modified form of tripod supports. The latter is thought to be least open to objection, as it reduces interference with the movements of the guns to a minimum. The topmast, yards, and wireless outfit have been landed in the dockyard preparatory to commencing the work necessitated by this alteration.

The cost involved in adding the director to the equipment of each dreadnought will exceed £5000, or a total extra cost to the Naval Votes of over £150,000 for ships completed or completing up to and including the *Marlborough* group of vessels, to which must be added additional expenses where mast alterations are necessary. The above considerations give point to the First Lord of the Admiralty's reference to the growing expenditure on fire-control and range-finding fittings in introducing the year's estimates.—*Naval and Military Record.*

POWDER.

INSPECTION SERVICE IN FRANCE.—M. Baudin declared in February, 1913, in the Assembly, that the new powders are above suspicion. They are not like the old. They are manufactured under constant supervision. We have done a great deal to better things. The inspection by naval officers in the factories has enabled a continual improvement to be realized, and M. Baudin states that he believes the progress will continue, due to the zeal of the powder service. The central navy laboratory is actually under construction, and a demand will be made of the minister of war for a capable powder expert to organize this central service, where will be united and controlled all the tests of powders—those of the factories, of the ships, of the proving grounds—to the end that real scientific progress may be made. The private firms will not be prohibited from powder manufacture, because experience has well proved the necessity of private enterprises to the improvement of the material. The navy and army are to co-operate in the powder question.

MARINE ENGINEERING.

THE GEARED TURBINE.—Judging from the 120,000 horse-power which is now under construction and from the opinions expressed in the discussion on Sir Charles Parsons' paper before the Institution of Naval Architects last week, the geared turbine has been received with very great favor, and in the words of one of the speakers, has "come to stay," There is no doubt, too, that many facts have recently come to light in support of this contention. The London and South-Western Railway steamers *Hantonia* and *Normannia* are stated to show an economy of 40 per cent over the other turbine steamers on the same service; this 40 per cent is partly due to the superior economy of the high-speed turbines, partly to the increased efficiency of the slower running propellers, and partly to the easier lines of the hull, due to the reduction in the boiler power found possible. Thus it will be seen that there are other factors to be considered beyond the mere superiority in economy of the high-speed turbine. There is also the rather remarkable saving of 15 per cent in coal shown by the *Cairnross* as compared with an ordinary reciprocating engine on a cargo steamer.

The curious thing is that the chief trouble anticipated by the shipowner—in passenger steamers, at any rate—is not the possibility of undue wear on the gearing, but that the noise of the gearing would have a disturbing effect upon the passengers, and it is remarkable how this point cropped up in nearly all the speeches that were made. The best evidence on the point is probably the fact that the London and South-Western Railway Company has not received a single complaint on this head, even though it is admitted that the gears were at first considerably more noisy than they now are. In the course of a recent trip on the *Normannia* in a cabin about amidships—that is, fairly near the engine room—although carefully listened for, the noise made by the gear was only evident when the engines were stopping or starting, when the alteration in the pitch of the note drew attention to it. This, too, in spite of the fact that Sir Charles Parsons admits that the machines upon which the gears were cut were incapable of turning out a very perfect job. It is really this point upon which his whole paper turns. The paper consists, in fact, of a description of the investigations made first into the sources of the noise and, secondly, of the machine devised for securing more accurately cut teeth in the gearing with the object of eliminating it. Even at the present very early stage of the investigations this machine is stated to have brought about the reduction of the noise to a fifth of what it was before. As far as the wear is concerned, very little was

said in the course of the discussion, but on the South-Western boats the high places on the tooth surfaces have been worn off and the teeth certainly now have the appearance of bearing well along their whole length. The lubricating oil supply for the gearing should be separate from that for the turbine. In the first place, with a separate oil supply it would be quite easy to make sure that each part was receiving proper attention, whereas if the big open nozzles for the gears draw their supply first from a single service the balance may be insufficient to supply the turbine properly, and in the second place it would allow of a different quality of oil being used for the two parts. An oil reduced in viscoscity, as it must be after circulating round a turbine bearing, is not in the best condition for lubricating gear wheels.

Thus we may probably take it that the helical transmission gear has now fairly well established itself as a successful commercial proposition. But there are two other types which were mentioned in the course of the discussion—the hydraulic and the electric. With regard to the latter we must admit that we were rather surprised to hear so enthusiastic an electrician as Mr. de Ferranti uncompromisingly condemn it for use at sea on the ground that the transformation of power into one form and then back again into its original form is not a commercial proposition. For ourselves we would prefer to put aside all questions of mere transmission or transformation efficiency and to wait till the ship which is now under construction with an electrical transmission gear has been put into service and shown us the actual fuel costs in transporting a given load at a given speed, which, as we have said before, is the figure which interests the shipowner. Dr. Föttinger supported his hydraulic transmission gear and claimed that though the actual efficiency is no higher than about 88 per cent, it would be about equal to that of the gearing when the losses due to the thrust and the running of the astern turbine are taken into consideration. This claim was strongly controverted by Sir Charles Parsons in his reply. However, on this point, too, we shall soon have the facts, as a set of this gear is being applied to a 10,000 horse-power turbine, which will very shortly be afloat. It should perhaps be pointed out that this form of transmission has its limitations as a speed reduction ratio of only 7½ to 1 is attainable with a two-stage transformer, or 10 to 1 with three stages—with a further reduction in efficiency—as against the 26 to 1 with gearing. On the other hand, the hydraulic arrangement contains within itself a reversing gear as well as a reduction gear, the efficiency of which may be gauged by the statement of Dr. Föttinger that during the trials on shore the 10,000 horse-power gear was reversed from full ahead to full astern in 10 to 12 seconds.—Editorial in *Engineering*, March 21, 1913.

GEARED TURBINE NOTE.—Extracts from an editorial review in *Engineering* of a paper of Mr. C. W. Cairns, M. Sc., read at a meeting of the N. E. Coast Institution of Engineers and Shipbuilders.—In his paper the author gave the results of a very carefully conducted comparative trial of two steamers, the *Cairngowan* and the *Cairnross*, the former being fitted with reciprocating engines, and the other with geared turbines. Both boats measured 370 feet by 51 feet by 27 feet 9 inches, and on the trial the displacement of the *Cairngowan* was 9891 tons, and of the *Cairnross* 9950 tons. The latter boat was, it will be seen, a little more heavily laden, but this was compensated for by its block coefficient being 0.779, in place of the 0.784 attributed to the *Cairngowan*. Both ships had an identical boiler equipment, consisting of three single-ended boilers, 14 feet 9 inches in diameter by 10 feet 6 inches, designed for a working pressure of 180 pounds per square inch. The engines of the *Cairngowan* had cylinders 24 inches, 40 inches, and 66 inches in diameter by 45 inches stroke, which on trial developed an average of 1790 indicated horse-power over a 36 hours' test, the mean speed being 61.68 revolutions per minute. The *Cairnross* had a high-pressure and a low-pressure turbine geared to a single main shaft, the

reduction ratio being 1 to 26.2. On the test the power developed was 1570 shaft horse-power, the propeller speed being 61.76 revolutions per minute.

The two boats were sent side by side over the same course and instructed to keep within sight of each other during the whole of the run. In the 36 hours' trial the *Cairnross* consumed 22,000 pounds of coal, and its reciprocating rival 27,200 pounds. Actually the turbined boat had a very considerable reserve of power since the pressure at the turbine stop-valve was 158 pounds only, as against 175 pounds, which was the corresponding figure for the reciprocating engine, and lighter boilers could have accordingly been used for the *Cairnross* without reducing its effective power below that of the *Cairngowan*. Special attention was paid to having the hulls of the two ships in a similar state of cleanliness, so that the results of these very important and interesting trials may be taken as conclusive evidence of the greater efficiency of the geared turbine as compared with good triple-expansion engines.

The question which next arises is, of course, the price to be paid for this higher efficiency. In the discussion which followed the reading of the paper, Mr. R. J. Walker stated that the cost of geared turbines was 5 per cent more than reciprocators for plants up to 1500 horse-power; about 3 per cent more for installations of between 1500 and 3000 horse-power; whilst above 5000 horse-power the cost of the two was the same, and these estimates were confirmed by Mr. Allen of Messrs. Hawthorn, Leslie & Co. Since the geared turbine showed an economy of 19 per cent on the coal taken to do the same work, it is obvious that even in comparatively low-powered ships it has very substantial advantages over its rival, and these would be accentuated by a saving in lubricants and in the cost of overhauls.

English engineers have never taken kindly to the floating frame originally introduced by Messrs. Melville and McAlpine, since it was difficult to see how the elasticity provided could be of much service in practice. The pitch-line speeds are high, and the inertia of the pinion and frame very considerable, so that a badly-formed tooth would have come into gear and gone out again before the frame could adjust itself, as it was theoretically designed to do. The view is certainly strongly held here that the true solution of the gear question is that proposed by Sir Charles Parsons, viz., to produce teeth substantially free from errors of form. His confidence in this solution of the gear problem is well illustrated by the fact that a gear is now in course of construction in which 6000 horse-power is to be transmitted through a single pinion. The results of the trials of this gear will certainly prove of great interest and importance.

The reduction in the size of the turbines due to the introduction of gearing will do much to facilitate the use on shipboard of highly superheated steam. A superheat of 200 degrees F. reduces the steam consumption per shaft horse-power by about 18 per cent, and the fuel bill by about 12 per cent.

Another important innovation which he is simultaneously introducing into marine practice is the use of thrust-blocks of the Michell type. These have been before the public now for a good many years, but engineers, even in this country, have been slow to realize their advantages, and apparently they are still less known abroad. Dr. Föttinger, for instance, spoke of thrust-block losses being about 1 per cent of the total power developed, and this is not an over-estimate for the old type. With the Michell type the loss is not more than one-tenth of this figure.

REVERSING TURBINES.—It would seem that, judging from particulars which have been published recently in our contemporary, the *Shipping Gazette*, a considerable advance in turbine design has been made in the direction of obtaining equal efficiency and speed in both directions of rotation, without the necessity of any provision of special reversing blades or separate rotor. This departure, which is the invention of Mr. John Wilson, of Belfast, has the other important advantages of small volume, quick

reversal and easy manipulation, and lastly, the capacity of being instantaneously reversed from the bridge by electrical means controlled by the captain or other officer in charge, should any special emergency require such action, for example, to avert a collision. The main feature is a rotatably mounted stator and a main rotor in a casing, which latter is stationary. If one realizes the point that the rotor revolves owing to the reaction of the stator, it will be seen that if these two elements be made to change places, then the original stator will as a rotor revolve in an opposite direction to that of the original rotor. The invention in question is, broadly, the provision of clutching and holding means by which either of the elements can be alternately coupled to a driving shaft axially common to the two or held stationary relatively to the casing. It follows that in getting the above result a considerable amount of additional invention is involved in the specific construction of the two elements and their arrangement in the casing, so that the motive fluid can be applied whichever element is the moving one. In effect, the means adopted comprise a fore and aft arrangement of clutch and brake mechanism at each end of the turbine, in such a way that the forward clutch and aft brake are associated with the main rotor, and the after clutch and forward brake are associated with main stator. The clutch is for coupling the element which is a rotor for the time being with the main shaft, and the brake is for holding the stator for the time being stationary to form an abutment against which the motive fluid re-acts. By the simultaneous action of the brake and clutch mechanism, one element can take up the drive in the reverse direction before the other element has finished revolving in its original direction. To do this it is not necessary to cut off the steam, and the interchange is effected without any shock. There is a variety of ways for effecting the operation of these controlling mechanisms, for example, by steam or hydraulic pressure, or by vacuum from the condenser, or by an electric motor and screw device. We understand that an experimental turbine of 100 horse-power has been built and exhaustively tested with the most satisfactory results. It would seem at the moment that the Parsons type of turbine is the most applicable for the new system, but we have little doubt that the other systems, such as the Curtis, Rateau or Zoelly can be equally dealt with when the construction problems have been attacked and solved.—*Marine Engineer and Naval Architect.*

TURBINES FOR THE NEW CUNARDER.—There are some special features about the turbines for the new Cunarder *Aquitania* which are of interest to engineers. Previously in Parsons marine turbines, however many cylinders, there have been only two in series from a thermal point of view, the expansion being divided into high and low pressure stages. In the new liner there will be three stages—high, intermediate, and low pressure—although the last will be divided between two cylinders in parallel, so that there will be four ahead turbines, one on each propeller shaft. The thermal advantage of this arrangement is not so great for a turbine as for a reciprocating engine, but it somewhat reduces the seriousness of a breakdown in one of the turbines. Another innovation is the provision of astern turbines on all four shafts, there being two high and two low pressure, thus giving greater maneuvering power and a quicker stoppage of the ship in the event of danger ahead. Super-heated steam is not to be used. —*Page's Weekly.*

FURTHER IMPROVEMENT IN THE STEAM-TURBINE-GENERATOR.—A distinguished British electrical engineer announces some very promising experiments in obtaining higher efficiency for the steam turbine, so increasingly employed in electric generating plants. The new method consists in re-superheating the steam after it has passed through one of the stages of the turbine, and using high temperature, the latter being rendered possible by coating the steel blading with sheet nickel. A 5000-kilowatt steam-tur-

STEAM TRIALS OF ENGLISH MEN OF WAR IN 1912.

Name of vessel	Type of vessel	Builders of vessel	Makers of machinery	Type of boiler	High-power trial		Full-power trial	
					S.H.P.	Coal per S. H. P. per hour	S.H.P.	Coal or equivalent of coal per S.H.P. per hour
Conqueror	Battleship	W. Beardmore & Co	W. Beardmore & Co	B. and W.	18,926	1.7	29,835	1.7
Thunderer	do	Thames Iron Works	Thames Iron Works	do	19,370	1.9	27,604	1.7
King George V	do	Portsmouth Dockyard.	Parsons Co	do	19,808	1.9	28,005	1.7
Lion	Battle-cruiser	Devonport Dockyard	Vickers, Ltd	Yarrow	54,763	1.7	75,685	1.7
Princess Royal	do	Vickers, Ltd	do	do	53,315	1.6	76,510	1.7
New Zealand	do	Fairfield Co	Fairfield Co	B. and W.	31,794	1.6	46,894	1.3
Dublin	"Town" class cruiser	W. Beardmore & Co	W. Beardmore & Co	Yarrow	22,606	1.8	26,041	1.8
Chatham	do	Chatham Dockyard	Thames Iron Works	do	22,127	1.9	25,901	1.8
Melbourne	do	Cammel, Laird & Co	Cammel, Laird & Co	do	24,600	1.4	28,185	1.3
Southampton	do	John Brown & Co	John Brown & Co	do	23,607	2.1	26,493	1.6

—*Engineering.*

bine generator on this system was found to consume only seven pounds of steam per shaft horse-power, and a still better performance is expected, namely, six pounds of steam per horse-power, or a thermal efficiency of 24 per cent.—*Scientific American.*

ELECTRICALLY-DRIVEN VESSELS.—The *Tynemount,* while the first sea-going vessel to be electrically propelled, is in no sense an experimental proposition, but it will be possible from her trials to determine the possibilities of electricity in marine work. The *Tynemount* is a steel vessel, 250 feet in length, 42 feet 6 inches in breadth, 19 feet in depth, and carrying a total deadweight of 2400 tons on a mean draft of 14 feet in fresh water. The oil engines generating the electricity are two in number, each of 300 brake horse-power.—*Page's Weekly.*

"JUPITER'S" INSTALLATION.—The U. S. fuel ship *Jupiter,* electrically driven, is 572 feet long by 65 feet beam, draws 27 feet 6 inches, displaces 19,360 tons, and has a carrying capacity of 12,500 tons of coal and 375,000 gallons of fuel oil. Power is supplied by a six-stage steam turbine of American design, driving a 14,000 horse-power electric generator, the largest of its kind ever built, current from which is conducted to motors driving twin-screw shafts.

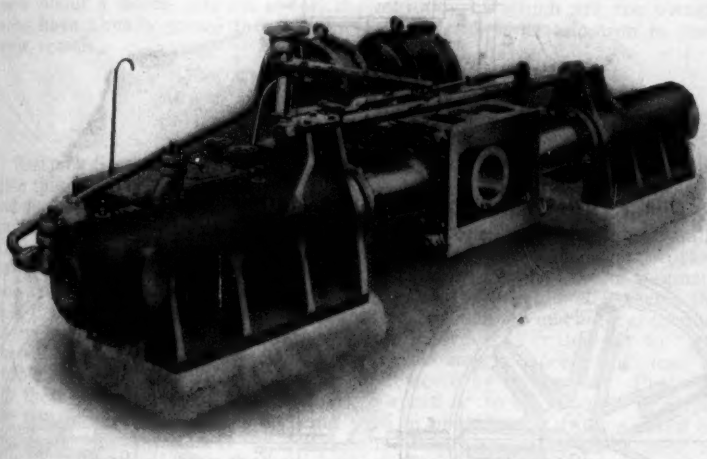


FIG. 1.—The Steering Gear of the Motor Ship *Christian X.*

ELECTRO-HYDRAULIC STEERING GEAR.—An article on the Hele-Shaw Martineau steering system appears in the March *Shipbuilder.* This abstract of the paper will be of interest to those who read the article by Ensign Edwards on Steering of Ships by Electricity, that appeared in the March issue of the PROCEEDINGS, No. 145.

This gear, as made by Messrs. John Hastie & Co., Ltd., of Greenock, is illustrated by Fig. 1. By reference to the diagrammatic sketch of the gear given in Fig. 2 it will be seen that the tiller A, fixed to the rudder stock, is operated by two hydraulic cylinders and rams B_1 and B_2. The passage of liquid to or from these cylinders through the pipes F_1 and F_2 is controlled by the Hele-Shaw pump C, which is driven continuously by the electric motor D. The spindle E controls the operation of the pump. This spindle is so arranged that when in the mid-position no flow of liquid takes place, although the pump is running. If it be pulled out from the pump, liquid

is sucked from the cylinder B_1 through the pipe F_1 and flows through the pipe F_2 to cylinder B_2. If the spindle E be pushed in, the opposite action takes place. The end of the spindle E is coupled to the middle of a floating lever G, one end of which is provided with a connection H to the telemotor or control shaft, while the other end is connected to the tiller by the

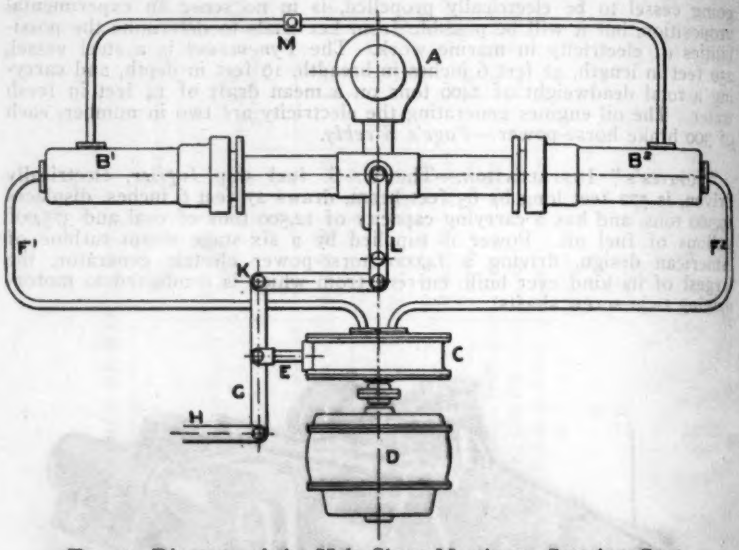


FIG. 2.—Diagram of the Hele-Shaw Martineau Steering Gear.

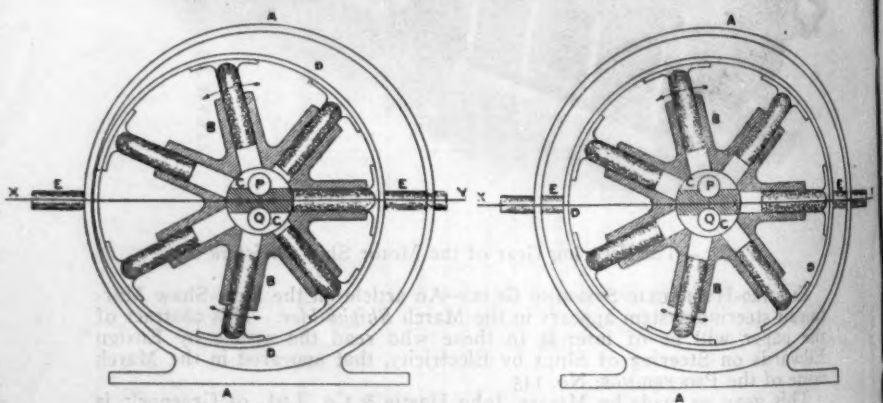


FIG. 3.

arm K, acting through the medium of the lever L. When the arm H is moved, the lever G and spindle E also move. Liquid at once flows to one ram and the rudder is operated. The tiller in moving, however, alters the position of the pivot K of the floating lever G, through the action of lever L, and in so doing returns the spindle E to its mid-position. The rudder then stops and is held in position until the arm H is again actuated. A

spring-loaded bye-pass valve is provided at *M* and is arranged so that, should the rudder be subjected to severe shock, the stress will be relieved at a predetermined value and the rudder allowed to give way. When this occurs, however, it brings into action the spindle *E*, and the pump immediately brings back the rudder to its previous position. Oil is used for the liquid instead of water, as perfect lubrication of the working parts is thus ensured and temperature effects are eliminated.

The Hele-Shaw pump is similar in its action to the variable speed or Waterbury Tool Co.'s gear. Fig. 3 shows a sectional view. The shaft *E* moves the circular frame *DD* about in the casing *AA*, thus making *P* and *Q* supply and delivery passages for the oil as required and in the degree required.

The first gear of this type was fitted in 1910 on the steam yacht *Albion*. The second vessel to be provided with the gear was the triple-screw steamer *Orama* of the Orient Line. This vessel has now completed four voyages around the world and no trouble has been experienced with the gear, while the coal consumption is only about 1 cwt. per day. Other vessels which have been, or are to be, fitted with the gear are the Austrian Lloyd steamers *Wien* and *Helouan*, the East Asiatic Company's motor vessels *Selandia* and *Jutlandia*, the Hamburg-Amerika motor vessel *Christian X* (the gear shown in Fig. 1), the large passenger steamers now building for the Stoomvaart Maatschappij "Nederland," the motor vessel *Belgika*, and H. M. torpedo-boat destroyer *Hardy*. Messrs. Hastie have now about a dozen sets on order, the majority of which are for owners who have already tested the gear and are extending its adoption to their new vessels.

MISCELLANEOUS.

SPEED OF SUBMARINES.—From a strategical point of view, it is not probable that much advantage can be gained from the attainment of the highest submerged speeds that are practically possible, for it has to be remembered that there is in submarines a double system of propelling machinery, usually Diesel engines for surface, and motor drive by means of electric storage batteries for submerged conditions. It is therefore impossible to augment one system without doing so at the expense of the other, and it seems the best distribution of the weight available for propelling machinery, to give the vessel the maximum of surface speed, in order to enable her to "get there," and to provide a quite moderate submerged speed, sufficient to enable her to deliver a torpedo while undetected by the enemy. Probably for these vessels a maximum submerged speed of 10 or 11 knots is ample the remaining available weight being used in providing a surface speed of 16, 18, or even 20 knots, if the dimensions of such vessels are increased, as it is likely they will be in the near future. The limit to useful speed, when submerged, will possibly soon be reached, but the surface speed may be augmented with great benefit to the attacking value of the vessel. Mr. Chace gives the following example of dimensions and powers for such a vessel from the curves of resistance, assuming 50 per cent efficiency: Length on load-line 232 feet; surface displacement, 1200 tons; submerged displacement, 1536 tons; approximate power to attain 10 knots submerged, 660 indicated horse-power, and for 20 knots on the surface, 6280 indicated horse-power; but he considers that these figures could be improved upon with the same displacement. It is clear that the development of the submarine depends to some extent upon the development of the internal combustion oil engine, for the Diesel type of engine has proved itself so suitable that it has no serious rival. Long non-stop runs are continually being made and now that the reliability of the larger sizes of these engines is assured, there seems little to prevent a great expansion in submarine design.—*The Engineer*.

DIMENSIONS OF SOME OF THE LARGE PASSENGER STEAMERS OF THE WORLD.

Vessel	Owners	Displacement	Gross tonnage	Length	Beam	Molded depth	Draft	Mean speed	I. H. P.	Type of machinery
Aquitania	Cunard	49,400	47,000	902	97	64	34	23.5	60,000	4 turbines.
Vaterland	Hamburg-American	.....	55,000	950	100	....	....	....	.....	.....
Imperator.....	Do.	.....	50,000	919	98	65	....	22.5	60,000	4 turbines.
Olympic.....	White Star	.....	45,000	883	92	64	....	22.7	46,000	2 reciprocat'g, 1 turbine.
La France.....	French	27,000	24,448	714	76	52	30	23.6	46,370	4 turbines.
Mauretania	Cunard	38,000	32,500	790	88	60	33.25		68,000	Turbines.
Kaiser Wilhelm, II	North German Lloyd	26,000	20.000	706	72	52	29	23.5	38,000	Reciprocat'g.
Deutschland	Hamburg-American	23,620	16,502	684	67	44	29	23.5	36,000	Do.
Campania.....	Cunard	18,000	12,500	622	65	41	25	22	30,000	Do.
St. Paul.....	American	16,006	11,629	554	63	42	26	21	18,000	Do.

FRAHM ANTI-ROLLING TANKS.—The study of anti-rolling tanks, which has lately been attracting so much attention in Italian naval circles appears again by Major Pecoraro in an interesting article appearing in the March number of the *Rivista Marittima.*

The Frahm anti-rolling tanks represent the highest point as yet attained in the struggle to solve the problem which was almost unveiled by Froude when he discovered the importance of synchronism—the basis of the theory. The efficacy of the invention depends, in fact: (1) On the period of oscillation of the water in the tanks being equal to that of the ship; (2) on the phase of the water being a quarter of a period behind that of a ship and half a period behind that of the normal to the surface of the effective slope of wave.

The author discusses at length the theory and method of construction of the Frahm tank and the means of ensuring a proper regulation of the flow of water and of obviating the two great evils of noise and danger from excessive concussions; Frahm's formulæ are added for the determining of the shape, position, and dimensions of the tanks in a given ship. The examples adduced are those of a battleship of 26,000 tons, one of the *Cavour* type of 21,550 tons, a Transatlantic steamer of 52,000 tons, and a tugboat of 266 tons. The position of the tanks is naturally kept as low as possible in the two former, and as high as possible in the two latter, while the length of tank and weight of water work out at 85.3 feet, and 456 tons in the first case; at 74.13 feet and 402 tons in the second; at 33.12 feet and 258 tons in the third, and at 10.8 feet and 17.56 tons in the fourth.

The unquestionable results given by this invention have, in fact, caused it to be applied up to December 31, 1912, to 23 steamers, almost half of which are of the largest tonnage, as, for instance, the *Imperator* and the other two monster Transatlantic liners of the same type which are still in construction. In the English Navy they have been fitted on the *Orion;* in the German fleet on the armored cruiser *Moltke* and, it is believed, on the *Friedrich der Grosse,* on the four vessels of the *Nassau* class, and on the ships following the *Blucher* and the *Scharnhorst.* It is also rumored that they will find place on the *Kaiser* type battleships and on those of the French programme of 1913. No details have as yet been published of the results obtained in practice on ships of the above class, but it is whispered that the *Friedrich der Grosse* has shown remarkable stability in an exceptionally heavy sea, and that the superiority of the *Blucher* over her sister ship, the

Elsass, in this respect was very marked while on a long cruise made in company.

Not only has greater stability been gained with all its advantages, but the column of water in the tanks, being divided by diaphragms and controlled by the air valve, is now no longer dangerous to the structure of the ship nor productive of the intolerable noise which characterized the dawn of the invention. To arrive at perfection, however, in the matter of anti-rolling tanks they should, says Major Pecoraro, be absolutely automatic, and this point of excellence Herr Frahm cannot truthfully be said to have as yet attained. His tanks are automatic only in the hypothesis of the ship being in regular waves and of her maintaining the same period of oscillation in a heavy sea as she does in calm water. But in reality a heavy sea is usually confused and irregular, and this difference between theory and practice necessitates regulation on the spot of the water column by the air valve. But a solution of this difficulty ought not to be far off, and the invention certainly represents, even in its present stage, a new victory of naval engineering.—*Engineer.*

RADIO.

On March 21 messages sent by the radio station at Arlington, Va., March 20, were heard by Eiffel Tower. Arlington was unable to hear Paris owing to the static condition of the atmosphere. For a successful determination of the problem of determining the difference in longitude between the observatory in Washington and Paris it is necessary to have intercommunication, but owing to the approach of unfavorable weather for radio transmission this may not be effected. However, the preliminary arrangements will be made, and the officials of this Government will become acquainted with the instruments of precision brought by the French officers and the methods proposed for the required determination of longitude difference, so the final determination made next winter, when conditions for transmission are at the best and the power of Eiffel Tower has been increased, will be made with the least expenditure of time. A further problem in connection with the experiment is that which concerns the velocity of the electric magnetic waves, and it is hoped that the data obtained will show whether or not this is the same as that of light, 186,000 miles per second, which it has been assumed to be in the past.

When the high-power radio station was built at Arlington, near Washington, the contract provided that Arlington should be able to transmit messages day or night to vessels at sea at least 3000 miles away, and that ships could likewise get messages to Arlington when within 1000 miles of that station. To test this, the Navy Department sent the scout cruiser *Salem* across to Gibraltar. The vessel succeeded in maintaining communication for a distance of 2383 miles in daylight; and by attaching wires to kites the messages came in so loudly that it is stated that unquestionably messages could have been received during the entire trip. Other test work prevented continuous kite-flying. Signals sent at night were received during the entire trip. Advantage was taken of the special nature of this trip to test out various experimental apparatus. Most gratifying results were obtained.

AVIATION.

GERMAN AIR FLEET ESTIMATES.—Extensive proposals for the construction of an air fleet for the German Navy have just been published. They involve a total expenditure, from 1914 to 1918, of $12,100,000, of which $726,000 is immediately to be provided for by supplementary naval estimates. It is proposed to construct in the next five years two groups of

four airships, each to form part of the active fleet and one airship each for the material reserve, together with four double revolving sheds and one fixed shed, gasworks, barracks for the *personnel*, etc. The airships are calculated to have a life of four years, and will therefore be renewed at the end of that period. The construction of a central station and six outside stations, with a total of 50 aeroplanes, is also planned, of which six groups of six each will be on active service and 14 airships will form the material reserve. The central station will be provided with flying grounds and will be capable of accommodating all the aeroplanes, while the outside stations will have space for 10 each. Aeroplanes will be replaced according to requirements.—*The Engineer.*

THE DESTRUCTION OF A GERMAN AIRSHIP.—On March 19 the German military airship *L. Z. XV* was destroyed in a storm on the drill grounds at Karlsruhe. It had started from Baden-Oos, where it was stationed, on the evening of the 18th, and had remained in the air until the afternoon of the following day, when it was obliged to descend in order to replenish its stock of fuel. A strong wind was blowing at the time and it was found impossible to land before the shed at Baden-Oos, and the descent therefore took place on the open drill grounds at Karlsruhe. About half an hour afterwards, while preparations were being made for another ascent, a violent squall seized the airship and broke it in the middle; further damage was inflicted immediately afterwards by another squall, and in a short time the vessel was completely destroyed with the exception of the motors and propellers. By a fortunate circumstance no persons were in the airship at the time, so that the accident was not accompanied by loss of life. The *L. Z. XV* was 460 feet long, with a cubic capacity of 741,600 cubic feet, and was of the same type as the *Z 4*, which has just been supplied to the German Army by the Zeppelin Company. It was only completed two months ago and was the swiftest Zeppelin hitherto constructed. It remains to be seen whether this accident will have any effect on the German predilection for the rigid system, for there can be no doubt that rigid airships of this size are particularly subject to accidents in stormy weather.—*The Engineer.*

FRENCH DIRIGIBLE CONSTRUCTION.—In France a new dirigible airship, the *Astra-Torres*, is soon to be launched. Its cross section resembles a clover leaf, the gas bag consisting of three lobes, with longitudinal steel cables at the junctions, these three cables connected with other cables, to form a triangular steel girder, with the triple gas bag extending from bow to stern. This model is said to be perfectly flexible when collapsed and capable of being closely packed for transport. As rigid as a Zeppelin when inflated, it can make a high speed without pocketing at the bows.

USES OF AEROPLANES.—Captain Chambers gives these as the contemplated uses of aeroplanes in naval warfare:

A. They can be carried, stowed and used by all large ships. (1) To reconnoiter an enemy's port or to search out his advanced bases and to assist in the operations of a blockaded or of a blockading force; (2) to locate and destroy submarine mines, submarines and dirigibles, and to assist in the operations of submarines and torpedo-boats; (3) to damage an enemy's docks, magazines, ships in repair or under construction, dirigible sheds and other resources; (4) to provide means of rapid confidential communication between a fleet commander and the commanding officer of a co-operating force on shore, or the commander of another fleet or division.

B. They can be carried by all scouts and large cruisers. (5) To extend the "eyes of the fleet" in naval scouting.

C. They can be carried, with ample supplies and camp outfit, on board any naval supply auxiliary. (6) For scouting at advanced bases and for extensive use with expeditionary forces.

SCOUTING RESULTS.—The British Army maneuvers in 1912 were remarkable for the success of the reconnaissances effected from aircraft, yet there was one notorious failure. The Blue division succeeded in performing a march of about 16 miles, entirely unseen and unreported by the Red airscouts, yet these latter were watched by the Blue troops from the ground level, sailing overhead in various directions. If such an incident were related in the history of a campaign it would seem incredible, but it actually occurred nevertheless. This result was secured by simple expedients. The troops started their march during the night and covered as much ground as possible before daybreak. During daytime they kept in small detachments and took every advantage of the shelter of the trees, and when halted, or on being warned by whistle of the coming of an aeroplane, stood, sat or lay close under the hedge-rows at the side of the roads, or under any umbrageous cover which could be found. The white bands on their caps and anything noticeable about their accoutrements were covered up, and guns and wagons when moving in the open were masked with straw to simulate country carts and farm wagons. Therefore, if under favorable atmospheric conditions the 12,000 men and horses of the division could succeed in escaping the observation of aerial observers, it is hardly to be expected that aircraft will be able to entirely take the place of cavalry in reconnaissance.

AIRSHIP COMPARISONS.—The airships of the Great Powers are:

	Number	Cubic feet capacity
Germany	24	8,896,000
Austria	8	1,453,000
Italy	7	737,000
Total for Triple Alliance	39	11,086,000
France	20	4,492,000
Russia	11	1,221,000
England	4	288,000
Total for Triple Entente	35	6,001,000

Further figures show that early in the present year the Triple Alliance total will be 47 airships of 13,886,000 cubic feet capacity, and the Triple Entente total 39 airships of 8,401,000 cubic feet capacity.

It is admitted that no reliable inference can be drawn from these figures of the relative striking and defence powers, but taking the hydrogen capacity of English airships as the unit, German air power is 41 times, France 24 times, Austria 6 times, Russia 5 times, and Italy 3 times as great as England.

BOOK NOTICES.

"Cours de Navigation et de Compas de l'École Navale de France." Edited by Lieutenant de Vaisseau Marguet. Published by Augustin Challamel, Paris. 370 pages.

This is a work in which the subjects of navigation (principally nautical astronomy) and the deviation of the compass are treated from a purely mathematical point of view. As such, it will be of interest to persons pursuing a theoretical study of those subjects.

To those seeking a working knowledge of navigation and the compass with a view to applying the same under conditions existing aboard ship, the work cannot be recommended. Many subjects are treated that have no application in practice, and much is omitted which the practical navigator would find of vital necessity in his every-day duties. There are no concrete examples to illustrate the working-out of the formulas, and no forms for the systematizing of computation and the avoidance of error; there is no explanation of the practical methods of acquiring and deducting data for the sights; methods of determining position in sight of land are but lightly touched upon, and other deficiencies of like character might be enumerated.

A naval student familiar with higher mathematics might, however, find many features in the book which would be of value either as an introduction or a conclusion to a more practical course in the subjects treated.

G. W. Logan.

"A Naval History of the American Revolution." By Gardner W. Allen. Published by Houghton Mifflin Company, Boston. Two volumes, xii + 752 pages. Price $3 net.

The opening sentence of this work, "The Americans of the eighteenth century were notably a maritime people," can have no better demonstration than in the numbers later recorded as having taken part in the Revolution. The Continental Navy included, during the whole period, 98 vessels, 29 of which were of 20 guns or more; the state navies (figures for the whole of which are not given) had ships greater in number but inferior in size and armament; the privateers, by far the most popular branch because of the alluring chance to the officers and crew of becoming rich by a single voyage, had no less than 1697 vessels, with an aggregate of 14,872 guns and 58,400 men. And the ships were active. In 1776 the British lost by capture 342 vessels, over 60 of them taken by the Continental Navy. The number of captures later increased, and in 1781 amounted to 625; the Continental and state navies had already declined, but the privateers continued active and the French were lending their assistance.

Dr. Allen in this work has related with more detail than any previous writer the varying fortunes of our widely scattered collection of ships,

brigs, galleys, schooners, gondolas, brigantines, packets, xebecs, and what not. He constantly cites his authorities and gives much important material heretofore inaccessible, gleaned from archives and private collections of our country and of England, captains' reports, log books, newspapers, and other contemporary documents.

He groups the events occasionally by subject, as in the chapter on "Washington's Fleet, 1775 and 1776," but more often merely by year, as "Naval Operations in 1779." The latter is a method that does not adapt itself easily to a nice unity, and because the author has attempted to be thorough, introducing for the sake of completeness the record of hundreds of chases and small engagements of no apparent significance, the work is in many spots dull reading. But on the other hand there are the incidents that appeal strongly to the imagination. Such was the taking of a prize by Captain Rathburne of the sloop *Providence;* she was a ship from Glasgow whose strange fortune it was to be taken by an American privateer, retaken by the British, and then captured again by the *Providence;* Rathburne succeeded in taking her into port without further change of flag. Another was the exploit of Commodore Whipple, who, with the three small ships under his command, one foggy morning fell in with a Jamaica fleet of 150 sail, convoyed by a 74, and several frigates and sloops of war. As the fog lifted at 11 o'clock and the American ships found themselves in midst of the fleet, they sailed quietly along, occasionally sending one of their boats on board an Englishman, who supposing it was a communication from an English frigate made no resistance until too late. In this way Whipple remained with the fleet all day and at night slipped away without raising an alarm, taking with him his prizes, 11 in number. However the old-time hero, John Paul Jones, continues to be still the most interesting. He is the only one that has distinct personality; strictly in keeping with his exploits are several of his letters, which show a breadth of view and a comprehension of naval strategy far beyond that of any other officer of his time.

Certain features of the work we could wish were different. The most important has already been suggested: the rough grouping of events, not because they have any relation in tactical plan, field of operation, or general result, but because they occurred in the same year. Although the Marine Committee, Board of Admiralty and Agent of Marine felt each in turn how hopeless was the task of fully coordinating the operations of the much scattered Continental Navy, they all made the effort. This is too often quite lost sight of. And it is confusing to have treated in the same chapter the operations of the Continental Navy, of the state navies, and of the privateers. Also we could wish that the author had relegated many of the captains' reports and ships' logs to footnotes or the appendix. They contain material valuable for the student intent on research, but the quoting of two, three, or more reports of an engagement, as is frequently done, is not a means of making the action luminously clear; and as for the pleasure of reading page after page of the log books, we should as soon think of turning to the sear "Anglo-Saxon Chronicle."

There are, however, considerations more important in history than pleasant reading, and whereas there are a dozen popular works that

lightly touch on the naval events of the Revolution none has presented anything like the rich material that we have as a result of Dr. Allen's industry and research. It is stimulating to the student to turn to the sources and think for himself. Surprisingly general is the idea that the service of the navy in the Revolution is very nearly limited to the deeds of the one popular hero. Dr. Allen shows how extensive were its operations. Again and again he points to the fact that privateering, although of aid in making the war unpopular in England, diverted men and money from the regular navy—for the lack of which the latter was increasingly embarrassed—and on the whole made a poor substitute. He shows that the most important service of the navy was commonly, not in opposing the warships of the enemy, but in capturing military supplies intended for the British forces and so much needed by Washington's destitute army; in protecting our commerce so that it continued with Europe throughout the war; in maintaining communications with France, carrying diplomats to and from that country, and thus finally in enlisting her aid, which was our salvation. The author says in conclusion, "The Revolution would have failed without its sailors," an assertion he has amply justified.

CARROLL STORRS ALDEN.

"Le Cuirassé et Ses Ennemis Sous-Marins." By Lieutenant de Vaisseau Georges Blanchon. One volume, 8 mo., paper cover. Published by Berger-Levrault, 5-7 rue des Beaux Arts, Paris. Price 70 cents.

The changes and progress in naval material that have come about so rapidly entitle a battleship to be considered as the finest product of modern science. A nation is thus forced to consider as a problem of the highest importance the exact composition of the naval forces which are essential to her existence. The author speculates as to what the future units of an offensive fleet may become; torpedo boats—"the arm of poverty"—, submarines—"this protector of the weak"—, or battleships that are battle cruisers.

The book is an interpretation of the naval evolution in the world, and, in bringing together into equilibrium the state and progress of navies, the author attempts to answer the questions propounded, and he gives a clear explanation of his views on the subject.

RALPH EARLE.

"A Landsman's Log." By Robert W. Neeser, with an introduction by Rear-Admiral Charles J. Badger. Published by the Yale University Press. 194 pages. Price $2.00 net, postage 16 cents.

This book describes the navy at work as it appeared to a civilian during his stay on board the *Kansas* with the Atlantic Fleet during four months. The period covered comprises the trip from New York to Guantanamo, the stay and drills at the latter place, the cruise to the southern drill grounds, elementary target practice and then to the navy yard.

All this is described in a very readable manner for civilians as well as seamen.

RALPH EARLE.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904.

The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut.-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

1907.

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

BATTLE REHEARSALS. A few thoughts on our next step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut.-Comdr. Yates Stirling, U. S. N.

THE NAVAL PROFESSION. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

1908.

A Few Hints to the Study of Naval Tactics. Prize Essay, 1908. By Lieutenant W. S. Pye, U. S. N.

THE MONEY FOR THE NAVY. First Honorable Mention, 1908. By Pay Inspector John A. Mudd, U. S. N.

THE NATION'S DEFENSE—THE OFFENSIVE FLEET. How Shall We Prepare It for Battle? Second Honorable Mention, 1908. By Lieut.-Commander Yates Stirling, U. S. N.

1909.

Some Ideas about Organization on Board Ship. Prize Essay, 1909. By Lieutenant Ernest J. King, U. S. N.

THE NAVY AND COAST DEFENCE. Honorable Mention, 1909. By Commodore W. H. Beehler, U. S. N.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT. Honorable Mention, 1909. By Pay Inspector J. A. Mudd, U. S. N.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY. Honorable Mention, 1909. By Commander A. P. Niblack, U. S. N.

1910.

The Merchant Marine and the Navy. Prize Essay, 1910. By Naval Constructor T. G. Roberts, U. S. N.

THE NAVAL STRATEGY OF THE RUSSO-JAPANESE WAR. Honorable Mention, 1910. By Lieutenant Lyman A. Cotten, U. S. N.

1911.

Navy Yard Economy. Prize Essay, 1911. By Paymaster Charles Conard, U. S. N.

NAVAL POWER. Honorable Mention, 1911. By Captain Bradley A. Fiske, U. S. N.

WANTED—FIRST AID. Honorable Mention, 1911. By Commander C. C. Marsh, U. S. N.

1912.

Naval Might. Prize Essay, 1912. By Lieutenant Ridgely Hunt, U. S. N. (retired).

INSPECTION DUTY AT THE NAVY YARDS. Honorable Mention, 1912. By Lieut.-Commander T. D. Parker, U. S. N.

1913.

The Greatest Need of the Atlantic Fleet. Prize Essay, 1913. By Lieut.-Commander Harry E. Yarnell, U. S. N.

NAVY DEPARTMENT ORGANIZATION. A Study of Principles. First Honorable Mention, 1913. By Commander Yates Stirling, Jr., U. S. N.

TRAINED INITIATIVE AND UNITY OF ACTION. Second Honorable Mention, 1913. By Lieut.-Commander Dudley W. Knox, U. S. N.